Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXVIII. APRIL, 1925 No. 4

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Contracts Awarded

ROADS AND STREETS

Ala., Mobile—Contracts let by City for paving 15 streets: Hancock Bros. 310 St. Michael St. Mobile, $44,547 for bitulithic pave., over sheet asphalt; asph. conc. pave., $128,074; one course conc. pave. $68,725; Morgan-Hill Paving Co. Woodward Bldg., Birmingham, and Hancock Bros. $45,210, sheet asphalt paving.

Cal., Los Angeles—G. A. Constantine, 488 I. W. Hellman Bldg., contract by Bd. Public Works for impvt. of 97th St.—120 ft. east of 5th Ave. and 108 ft. w. of 11th Ave.—at $62,918. Work involves curb, walk, culverts, grading, etc.; Roe A. Deal, 760 N. Wilton Pl. contract for impvt. of portion of Jennie Belle Ave.—Ave. 60 to 201.87 ft. east—involving light curb, walk, gutter, st. drain, oiled rdway., at $14,557; 71st St.—Main to Moneta Ave., involving concrete pave., curb, walk, etc. to Geo. R. Curtis Paving Co., 2440 E. 26th St., at $12,153; 7th St.—Lorena to Vista Dr., involving conc. pave. oiled rdway, curb, walk, gutter, to J. D. Phillips, 208 San Fernando Bldg., at $6,836; Concord St.—Inez to Whittier Blvd., involving conc. pave., oiled roadway, light curb, walk, gut. st. drain, reinf. conc. culvt., to J. D. Phillips, at $21,827; Cerro Gordo St.—Avon St. to S. Park Ave., involving conc. pave., curb, walk, gut. sewer, etc., to R. A. Wattson, 1026 McCadden Pl., at $10,580; Delta St.—Echo Park Ave. to s. e. line of Lucretia Ave., involving oiling and rolling, light curb, walk, gut. sewer, reinf. conc. stairway compl., to G. A. Constantine, 488 I. W. Hellman Bldg., at $8,046; Montana Ave.—Federal St. to San Vicente Blvd., involving conc. pave. asph. conc. pave. oiled rdway, curb, walk, gut. reinf. conc. pipe culvt. sewer, to L. A. Paving Co., 2900 Santa Fe Ave., at $43,535. Channel Constr. Co., 1030 Bank of Italy Bldg. awarded contract by Board of Public Works at $44,203 by Bd. Pub. Works, for impvt. of First St.—Harbor Blvd. to Pacific Ave.; Los Angeles Paving Co., 2900 Santa Fe Ave. contr. at $23,497 for cement conc. pavement, asph. conc. pavement, Warrenite pavement, gutter, etc. in portion of 2nd St.; Geo. H. Oswald, 366 E. 58th St. contract by Board at $59,560 for impvt. of Marine Ave.—Anaheim to A Sts., involving asphalt pave., curb, walk, gutter, storm drain, etc.

Cal., Newport Beach—Fleming Constr. Co., 105 N. Park Ave. Pomona, awarded contract by City for 4-in. conc. pavement, 66-in. conc. pavement, water system complete, etc. for impvt. of all streets in Balboa Island, at $183,339.

Cal., Pasadena—Ducey & Breitenstein, R. F. D. 3, Box 203, Pasadena, awarded contract at $105,084 for impvt. of Walnut St.—Lake to Allen Aves.; grading, 4-in. oil macadam pavement, curb, gutter, walk, reinf. conc. and curb. iron culverts, 8-in. vit. sewer main with 4-in. c. i. laterals, 106 met. lighting posts; C. F. Matthews, 221 Braley Bldg. Pasadena, contract at $25,104 for impvt. of Lake St., north City limits to south City limits of lot 2, Washington Sq. and portions of Rio Grande St., Curtis St., Denver St., Howard Pl.; Ducey & Breitenstein, R. F. D. No. 3, Box 203, Pasadena, contract for impvt. of Forest Ave., Wyoming to Montana Sts., at $3,958; oil macadam.

Cal., Sacramento—Following contracts let by State Hwy. Comn. for highway work: Yolo Co.—Woodland Wye to Woodland, at about $135,904; 12.8 miles in length to Kaiser Paving Co., Oakland; Merced Co.—Merced River to Buhach, abt. 6.4 miles; 5.3 mi. to be paved with cement conc. and 1.1 mi. to be widened with cement concrete shoulders, to H. H. Peterson, San Diego, at $139,367.

Fla., Largo—The J. B. McCrary Co., Atlanta, awarded contract by Town Commrs. for paving, at $400,000.

Fla., Tampa—Cone Bros. Caison & Walter Sts., awarded contract by City to pave streets in section west of W. Tampa, at $193,261.

Fla., Tampa—Union Paving Co., 29 Main St., Philadelphia, awarded contract by Hillsborough Co. Commrs., to pave various streets in Maryland Manor sub-div., at $569,350; W. L. Harwell, $13,097 for 3rd Ave. and R. E. Garretson & Co., $35,472 for Silene Street.

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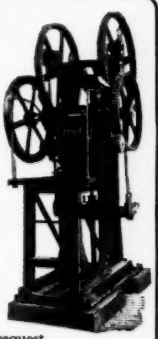

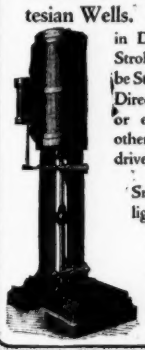

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Ill., Springfield—Following contracts let by Dept. Pub. Wks. & Bldgs., Division of Highways, March 1 to 7: Sec. 18, Kane-McHenry Cos. pavement to McGucken & Vander Heyen Co. Milwaukee, Wis., at $119,964; Sec. 17, Ogle Co. pave. to C. E. Carson Co., Chicago, Ill., at $94,145; Sec. 22, McHenry Co. pavement to Harrison Engr. & Constr. Corp., Kansas City, Mo., at $76,576; Sec. 14B, Pike Co. bridges, to Herrick Constr. Co., Carlinville, Ill., at $23,639; bridges in Lake Co. to Jno. F. Hinman & Son, Glenwood City, Wis., at $41,587; bridges in Schuyler Co., to Ill. Steel Bridge Co. Jacksonville, Ill., at $13,588; pavement on Sec. 34 Winnebago Co. to McCarthy Impvt. Co. Davenport, Ia. at $115,679. McLean Co. bridge to Jas. T. Pinkstaff, Lawrenceville, Ill., at $11,809; Shanks & Gannon, Watseka, Ill. contract for pavement in Iroquois and Cairo Cos., at $165,171, pavement in Carroll Co. to Stevens Bros. & McCree & Co., St. Paul, Minn. at $143,633, also contract for grading in Pike Co. at $79,919; paving in Will and DuPage Cos., to R. F. Conway Co. Chicago, Ill., at $344,188; bridges in Ford Co. to G. H. Goodlink, Lawrenceville, Ill., at $15,117; pavement in Mason Co. to Jansen & Schaefer, Pekin, Ill., at $101,379; paving in Vermillion Co. to Glove Constr. Co. Evansville, Ind., at $270,564. McCarthy Impvt. Co. 802 Kahl Bldg., Davenport, awarded contract for paving on Rte. 2—Rockford to Dixon—at $115,000. (Contr. let by Hwy. Department.)

Ill., Springfield—Following pavement contracts let by Dept. Pub. Wks. & Bldgs.: Geo. Welch, Beloit, Wis., at $53,167, pave. in Winnebago Co.; Alan J. Parrish, Paris, Ill., Vermilion, at $99,078; Chicago Hts. Coal Co. Chicago Hts., Ill. contracts for pavements in Cook Co. on Secs. 461, 463, 464 and 465, at $619,000; T. J. Crowley & Son, Centralia, Ill. contract for grading in Jefferson Co.; C. T. Laird, Pittsfield, Ill., contr. for bridges in Pike Co., at $32,478.

Ind., Indianapolis—Following contracts let by Marion County Comn.: Jno. Brill rd. Center Twp. to Winslow & Hooten, Greenfield, at $14,992; 5167 sq. yds. conc.; Chas. McGregor rd., Center & Perry Twps. 25,856 sq. yds. conc. to A. D. Bowen, Indianapolis, at $78,316; Jno. A. Esmon rd. Perry Twp. 22,678 sq. yds. Emulsified asphalt, to Emulsified Asphalt Co. Indianapolis, at $75.170; Jno L. Duvall rd. Washington Twp., asph. conc., 26,690 sq. yds. to Emulsified Asphalt Co. Indianapolis, at $94,878; J. F. Kassebaum et al rd. Washington Twp. 15,337 sq. yds. asph. conc. to Emulsified Asphalt Co., Indianapolis at $55,573; C. F. Fitch rd. Washington Twp., 28,922 sq. yds. asph. conc. to Emulsified Asphalt Co., at $109,386.

Ind., Rising Sun—Ohio County Commission awarded 3 crushed stone roads to Sparks & McClamrock, Kirklin as follows: Jas. Hastings Rd., .63 mi. at $4,091; Walter Potter rd., 2.6 miles, at $19,395; Leonard Cofield Rd., 5.82 miles at $46,683.

Ind., Washington—Daviess County Commission let contract for O. W. Barr et al road to E. O. Chattin Co., at $61,943; W. H. Myers et al rd. to Sherman Shake, at $25,985; Jesse F. Loming et al rd. to Jno J. Leichty, at $26,800.

Ky., Frankfort—Following contracts let by State Highway Commission: (Meeting of March 12)—Ohio County, Beaver Dam-Owensboro Rd. 7.810 miles, to Ellis & Smeathers, at $95,749 and Hickman-Mayfield Rd., Fulton Co., 12.53 miles, at $95,-561; Beaver Dam-Morgantown Rd. Ohio Co. 7.087 miles to W. W. Carter, at $35,396; Pike Co., Pikeville-Whitesburg Rd., 5.769 miles to Codell Const. Co., at $151,124; 11.949 mi. Hickman-Reelfoot Lake Rd., Fulton Co., at $56,663, to S. K. Johnson Constr. Co.; Hardin and Larue Cos., Elizabethtown-Hodgenville Rd. 4.735 miles to Costello Bros., at $39,025.

Ky., Owensboro—Ellis & Smeathers, Owensboro, awarded contract by Scott Co. for 15.9 miles grading and draining on Eastern Dixie Hwy., at $220,-344; also 10 miles graveling on Ohio River Rd. east of Smithland, Livingston County, at $80,952 (contr. let by Livingston Co. Work financed by counties and Federal Government.

Mass., Boston—Central Constr. Co. 228 Southampton St. Roxbury, awarded contract by City for bitum. repairing on any street not under guarantee, when ordered by Commr. from March 1 to Dec. 31, at $102,450.

Minn., Duluth—Thornton Bros. 318 Endicott Bldg., St. Paul, awarded contract for paving Congdon Blvd., at $124,652.

Mo., Jefferson City—State Hwy. Dept., let contracts as follows for 57 roads: Audrain Co. 3.939 mi. 18-ft. gravel, to H. S. Worman, Perryville, $34,-587; Caldwell Co. 2.765 mi. 30-ft. graded earth, Land Constr. Co., St. Joseph, 26,523; Cass C[illegible] 4.315 mi. 18-ft. gravel to Ben D. McCally & [illegible] Rensselaer, Ind., $35,117; 4.634 mi. 18-f[illegible]ey, Dexter Constr. Co. Dexter, $34,101; Cray[illegible] Co. Harrison Engrg. & Constr. Corp. 506 Mu[illegible] Kans. City, 4.708 mi. earthwk. $7,176, 4.[illegible] ft. conc. $86,507; 3.943 mi. earthwk. $5,91[illegible] 18-ft. conc. $72,454; Davies Co. 4.811 mi[illegible] gravel, Kiefner & Geile, Perryville, $16,441; Franklin Co., 2.178 mi. 12-ft. gravel, Richmond Constr. Co. Advance, $18,885; 2.397 mi. 12-ft. gravel, Dexter Constr. Co., Dexter, $15,119; Franklin Co. to Harrison Engineering and Constr. Co., Kansas City, 4.685 mi. 18-ft. conc. $866,087; 4.685 mi. earthwk., $17,774; 4.965 mi. 18-ft. conc. $91,034; 4.965 mi. earthwk. $15,428; Tibbetts & Tibbetts, Olathe, Kans.; 4.928 mi. earthwk. Gray Summitt east, $38,-528; 9.928 mi. 18-ft. conc. $96.753; Gentry Co. Roy Tanner Paving Co. Tulsa, Okla., 4.899 mi. 9-ft. conc., $52,308; 4.898 mi. earthwk. $19,078; Harrison Co. C. H. Atkinson Paving Co. Watertown, S. Dak., .962 mi. earthwk., $14,026; 4.848 mi. 9 ft. conc. $43,-520; 4,848 mi. earthwk., $17.594; Johnson Co., Jefferson City to Kansas City, A. A. Davis & Co., Grain Exh. Bldg., Okla. City, 2.896 mi. 30-ft. graded earth, $25,360; .309 mi. 30-ft. graded earth: 4.869 mi. earthwk.; 4.879 mi. 18-ft. concrete, $63,-794; 4. 868 miles earthwork; 4.868 mi. 18-ft. conc. $63,145; 4,216 mi. earthwork, $8,142; 4.216 mi. 18-ft. conc. $55,652; 4.659 mi. earthwork; 4.659 mi. 18-ft. conc., $61,393; Macon Co. 3.934 mi. 30-ft. graded earth, St. Jos. to Hannibal, to Gray Constr. Co. Mt. Vernon; 3,540 mi. 30-ft. graded earth, Macon E., to J. K. McClarrin, Alexandria Mo., $9,327; Marion Co. C. H. Atkinson Pav. Co. 2. 888 mi. 18-ft. conc. $30,805; 2.888 mi. earthwk. C. H. Atkinson Paving Co., 3.134 mi. 18-ft. conc. $34,755; 3.134 mi. earthwk. $15,176; Pemiscot Co. 2.083 mi. earthwk. to Dexter Constr. Co., $11,807; Polk Co., 1.135 mi. 16-ft. gravel, Easley Bros., Aurora, $10,200; Shelby Co. .35 mi. 30-ft. graded earth, Vincennes Bridge Co. Vincennes, Ind. $7,935; C. H. Atkinson Paving Co., 4.940 mi. 18-ft. conc. $52,150; 4.940 mi. earthwk. $20,825; 2.980 miles earthwk. $40,684; 2.980 mi. 18-ft. conc.; 2.615 mi. 18-ft. conc. $27,341; 2.615 mi. earthwk. $20,202; Webster Co. to D. C. Horton, Ft. Smith, Ark.; 4,793 mi. earthwork, $7,788; 4.793 mi. 18-ft. conc., $70,857; 3.746 mi. 18-ft. conc., $55,388; 3.746 mi. earthwk., $15,294; 3.898 mi. 18-ft. conc., $57,163; 3.898 mi. earthwk. $8,046; 1.784 mi. 18-ft. conc. $26,381; 1.784 miles earthwk. $8,089; Worth Co. Grant City to Sheridan, to Lamoreaux Bros. Omaha, Neb., 2.265 mi. 30-ft. graded earth, $5,936; 3.390 mi. graded earth, $20,644.

Mo., St. Louis—Board of Public Works let contracts to improve 11 streets: Three to Webb-Boone Paving Co., at $36,469; 2 streets to Trinidad Asphalt Mfg. Co., Rankin Ave., at $120,302; one street to Central Paving & Constr. Co., $54,684; 2 streets to Granite Bituminous Paving Co., at $25,904; 2 streets to Frank C. Stolle Constr. Co., F. St. Louis, at $36,786; 1 street to F. A. Grant, 3219 Halliday St.

N. Y., New York—Following contracts let: Curb, flagg, Chittenden Ave. to M. Del Balso, 660 E. 221st St., at $38,978; asphalt repaving Amsterdam Ave., to Gaffney Constr. Co. 450 E. 91st St., at $82,926; widening and granite blk. repaving on 14th St., to C. Helbock, 633 Wales Ave., at $100,579; granite block repaving on 34th St., to Poirier Contg. Co., 1476 Bway, at $68,057.

N. Y., St. George—J. Johnson Sons, 455 Broadway, West New Brighton awarded contract by Richmond Boro. Pres., J. A. Lynch, for grading, conc. paving, etc. in Hylan Blvd. at $285,313.

Okla., Okla. City—State Hwy. Dept. Okla. City, let contracts for 11 roads: Garfield Co. 13.68 miles conc. on Meridian Hwy. to H. L. Cannaday; Sec. D, $178,683, Sec. E, $158,711; Rogers Co. 9.91 mi. grading and bridge to Dan Blackburn; Sec. A, $29,-707; Sec. B, $19,880; Sec. C, $26,548; Garfield Co 9.5 miles grading, M. Butterton, $18,639; Nowata Co., gravel rd. to M. E. Gillioz, Monett, Mo., $39,-054; 2 sections to Tom Collins, $6,311; Canadian Co., 3.414 miles concrete; grading to H. L. Cannaday, $16,265; paving, Green-Boekman Constr. Co. 1200 W. 11th St. $75,367; Kay Co. 6.16 miles grading; Sec. A to Maney Bros. Co., Okla. City, $16,-

708; Sec. B, Dan Blackburn. Grain and drain 7 miles—Beggs to Mounds—Pharoah Bros. & Sharp, Henryetta, at $25,447; 8½ miles from Okmulgee to Okfuskee Co. line, to Ellis & Lewis, Muskogee, at $27,573; Creek Co. conc. rd.—Mannford to Bristow—to Henson & Pierce, at $144,988, bridge on Sapulpa-Mounds rd. to E. G. Fike, Nebraska Bldg. Tulsa, at $5,290; Sapulpa-Bristow rd, to Sam Ward, 540 S. Victor St., Tulsa, at $117,473; rd. east from Holdenville to Johnson Bros. Ardmore, $22,998; 5 miles grading, draining structs. and 8 miles gravel rd. in Hughes Co. to Standard Paving Co., 1742 E. Sixth St. Tulsa, at $264,574.

Ore., Portland—Greenwood & Damm awarded contract for grading 9.3 miles Stices gulch-Baker section of Baker-Unity highway, at $95,950; Washburn & Hall, contract for widening 2.2 miles Wolf Creek-Garces creek section of Pacific Hwy., in Josephine Co., at $25,095.

Ore., Salem—State Hwy. Comn. let contract to H. C. Boyer, Ontario, Ore., for unit No. 1, Baker-Cornucopia proj., at $16,160; Jas. Crick, Baker, Ore., contract for Sag-Halfway section, proj. 3, same highway, at $124,848.

Pa., Harrisburg—State Hwy. Dept. Harrisburg, let contract for rein. conc. surf. 7 ins. edges and 5 in. ctr. 34,390 sq. yds. Rte. 10, Appli. 1067, and 976, Susquehanna Co. to Lane Constr. Co. Meriden, Ct., at $169,962; grading, etc., 18,843 ft. Rte. 10, Appl. 3236 to McKean Co., to D. L. Dennis, Smethport, at $82,851.

Pa., Harrisburg—United Construction Co. Lock Haven, awarded contract by State Dept. Hwys. for 22,820 sq. yds. Rte. 236, Appl. 3063, Potter Co., at $101,602; H. T. Campbell Sons, Towson, Md. awarded contr. for 10,960 sq. yds. Appl., 550, York Co., at $57,648; Milligan & Ringler, Blairsville, contract for reinf. conc. surf. 7 in. edges and 5 in. center, 14,400 sq. yds. Appl. 985, Canoe Twp. Indiana Co., at $67,647.

S. C., Greenville—Nichols Contracting Co., No. 1 La France St., Atlanta, awarded contract for 4.754 miles State Rte. No. 2—point nr. Greenville to Mauldin—at $133,301.

Tex., Pearsall—Kelley & Lehr, 503 Barrell Pl., San Antonio, contract at $133,973 to grade, construct drainage structs. and lay 16-ft. gravel surf. on 14.86 miles, Frio Co.

W. Va., Bluefield—Ford & Harvey, Lynchburg, Va. awarded contract for about 24,000 sq. yds. one course conc. paving, at $141,050; Harry M. Waugh, Bluefield, contract to grade Hill Ave., at $5,742.

W. Va., Huntington—City let contracts to pave 3 sections of Washington Blvd.—Norway Ave. to Arlington Pl.: Hatfield Constr. Co. approx. $125,000; asph. on concrete base; L. J. Gillespie, $25,000; brick; George Pence, $85,000, concrete.

SEWERAGE AND SEWAGE TREATMENT

Ark., Rogers—J. S. Terry, Poteau, Okla., awarded contract for constr. of sewer in Southside, at $32,000.

Cal., Corona—R. F. Ware, 2146 E. 38th St. Los Angeles, contr. by City for construction of sewage disp. plant, Imhoff tanks, filters, sewer system, etc., at $100,921.

Cal., Los Angeles—C. Fisher, 1682 4th St. Santa Monica, awarded contract for vit. sewers in Georgia Ave.—26th St. to 21st Pl.—and others streets, at $31,000. Leo Vuksich, 1506 Pleasant Ave. awarded contract by Pub. Works, at $2,850 for sewer complete in Lecouvreur Ave.—L to J Sts., at $2,850. Thos. Haverty Co. 8th & Maple, awarded contr. by Bd. Pub. Wks. for constr. of sewer in Lakewood Ave. betw. Glendale Blvd. and Armstrong Ave. at $10,790; H. R. Erdman, 141 W. Main St., Alhambra, awarded contract by County for sewer piping, rainwater draing. connections, etc. at Olive View Sanitarium, at $3,718.89. U. S. Cast Iron & Fdy. Co. 705 Wright and Callender Bldg., awarded contract at $6,944 less 2% disc. cash payment within 30 days for cast iron pipe for Sec. 25, No. Outfall sewer; Culjak & Bebek, 425 W. 78th St., contract at $3,230.90 for sewer in Meadow Ave., also contract for sewer in Crockett Blvd.—76th Pl. to Florence Ave.—at $7,156.30. Frank H. Brigham, R. F. D. No. 7, Box 1290M award. contract for vit. sewer in Holmes Ave.—Florence Ave. to So. term. Holmes Ave. under Co. Impvt. No. 269, at $1,422.40; Claude Fisher, 218 Chapman Bldg. awarded contract at $13,521 for vit. sewer in Holmes Ave.—Florence Ave. and Slauson Aves. Co. Impvt. 277.

D. C., Washington—Warren E. Brenizer, 101 New York Ave., N. E., has contract at $31,000 for constr. of Ogden St., sewer.

Ga., Columbus—City Commission let following contracts for sewers: J. B. McCrary Co., Atlanta, for completing Cook's Branch sewer; Dysard Constr. Co., Austell Bldg., Atlanta, for Weracoba Creek sewer; Lock Joint Pipe Co. Ampere, N. J. and Sherman Concrete Pipe Co. Burwell Bldg., Knoxville, Tenn., contract for pipe.

Idaho, Pocatello—J. L. Griffith Co. Salt Lake City, awarded contract for local sewer Dist. No. 33, at $23,368.

Highland, Ill.—Fjellafold & Chapman, Forest City, Ia., contr., for 52,023 ft. 6-15 in. vit. clay sewers in various streets, 47,700 c. y. excav., 400 ft. 15-in. sewer on trestle, 275-ft. 8-in. pipe under railroad, 80 manholes, 62 catch basins, 13 drop manholes, etc., at $100,149.

Ind., Hammond—Ahlborn & Lavene, Hammond, awarded contract for system of sewers in Hammond steel city addn. and Douglas Park Manor, Lake County, at $122,801.

La., Amite—N. A. Forrest, awarded contract to install $65,000 sewerage system here.

Md., Baltimore—N. Martell, 417 S. Eden St. awarded constr. for san. sewer in Walbrook south of North Ave., at $36,180.

Mo., Kansas City—W. C. Mullins Constr. Co. 202 Nelson Bldg., contract for 8-25 inch san. sewers in Dists. 264, 295, 303, 337, 338, 339, 345, 346; 347; 348; 350 and 416 in Sewer Div. No. 4, at $34,063.

Mo., St. Louis—Board of Public Service, let following contracts: Hogan Contracting Co. Melbourne Hotel, contract for sewers in Oleathe Ave. Jt. Sewer Dist., at $18,,778; Glaise Crk. Sewer Dist. 16, at $10,441; Grant & Meinert, care Municipal Contractors' Ass'n., Fullerton Bldg., for sewers in Rock Creek Sewer Dist. 9, at $11,457.

N. Y., Long Island City—Hammen Constr. Co. 279 Madison Ave., Perth Amboy, N. J., awarded contract for san. sewers in 150th Ave. at $407,045; Sutter Ave. to J. H. Johnson, $138,480. Paino Bros. 32 Court St. Brooklyn, awarded contract by Pres. Queens Boro. for sewers in 150th Ave., at $749,240.

N. Y., New York—T. A. Reilly, 48 E. 41st St., awarded contract for sewers in Laurel Hill Terrace, at $44,990.

S. C., Clinton—Geo. C. Odiorone awarded contract by City for sewer system at $34,000.

S. D., Madison—McHose Sand & Tile Co. First National Bank Bldg., Boone, Iowa, awarded contract for sand filter plant and trickling filter, at $47,649.

Tex., Galveston—W. A. Kelso, 2270 C Street, awarded contract by City Commrs. for constr. of drains to 31st and 39th Sts., at $42,747.

Wis., Menasha—E. A. Yahr, Menasha, awarded contract for construction of Island sewer, at $26,855.

WATER SUPPLY AND PURIFICATION

Ala., Birmingham—U. S. Cast Iron Pipe Co. and Alabama Pipe Co., awarded contracts for furnishing cast iron pipe for Water Company's extensive impvt. program; 4,000 tons pipe ranging from 12 to 30 inches.

Ark., Altheimer—McEachin & McEachin Southern Tr. Bldg., Little Rock, have contract for water mains; Ernest Smith, Pine Bluff, contract for concrete found. for standpipe and reservoir.

Cal., Los Angeles—Ross Construction Co. Van Nuys Hotel, awarded contract by Public Service Commission for laying cast iron main under Los Cerritos Channel, at $5,430; Keystone Iron & Steel Works, 2931 Santa Fe Ave., contract for meter covers, at 3.45c lb.; Llewellyn Iron Works, Main & Redondo, awarded contract for riv. steel pipe, at $2,790. Lacy Mfg. Co. Washington Bldg., awarded contr. by Pub. Serv. Comn., ror riv. sheet steel tank on Mulholland Dr. at $22,238; Busch-Selzer Bros. Diesel Eng. Co., contract at $50,680, f. o. b. Los Angeles, for one Diesel eng. under spec. 749; General Elecq. Co., awarded contract for 2300-volt, 3-phase elec. equipt. for generating set under same specfs., at $6,714. Howard-Olsen Co., 2103 Santee St., awarded contract at $24,645 for fire protection system, and serv. main from water softeners at Olive View Sanitarium, Sylmar.

Cal., Inglewood—American Cast Iron Pipe Co., awarded contract for 3,000-ft. 6-in. cast iron water pipe at 87c ft.; Grinnell Co. awarded contract at 58c ft. for 3,000 ft. 4-inch.

Ga., Columbus—W. A. Coates Constr. Co., 202 Bell St., awarded contract by Albert Woolfolk for water, gas, san, and storm sewers, etc., in Cherokee Hts. sub-div.

Ia., Glenwood—Layne-Bowler Co. 37 W. Van Buren St., Chicago, Ill., awarded contract for well with capy. of 200 gals. per minute, at $18,900.

Ia., Grinnell—Electrical Equipment So. 213 Grand, Des Moines, awarded contract for addition to water works pumping plant and equipt., consisting of air compressors, centrif. pumps, motors, piping, bldg. remodel, at $9,814.

Md., Baltimore—Following contracts let by Board of Awards: Cast iron pipe and fittings to U. S. Cast Iron Pipe Co., Burlington, N. J., at $162,600; 250,000 lbs. pig lead to N. Trotter Co., 36 N. Front St., Philadelphia, Pa., at $24,425; 150,000 lbs. lead substitute to Leadite Co., 1512 Land Title Bldg., Philadelphia, Pa., at $18,285.

Minn., St. Paul—D. W. Moore & Molin Bros. 894 Edmund St., awarded contract for Vadnais Lake-McCarron Station conduit, at $768,173.

Minn., Stillwater—McCarthy Well Co. Wabash & Eustis Sts., St. Paul, awarded contract for drilling and casing deep well in Stillwater, at $10,950.

Miss., Natchez—Chicago Bridge & Iron Works, Atlanta, Ga., awarded contract for 500,000 gal. steel water tower, 150 ft. high; $30,000. Chas. Brassfield, Chrmn. Water Comn., let contract.

N. C., Charlotte—W. A. Ebert, Latta Arcade, has contract for laying water main connecting with City's water system. Est. cost. abt. $50,000.

N. C., Hickory—Boyd & Goforth, Charlotte, awarded contract for constr. of West Jefferson gravity line for Hickory, N. Carolina water works. Contract calls for gravity line of 18,000 ft. water mains and 2 reservoirs of 100,000 gals. capy. Expenditure involved is abt. $45,000.

Ohio, Cincinnati—M. F. Quill & Son, 409 Gerke Bldg., awarded contract by City for cast iron pipe, special castings, valves and other miscel. work in connection with water distribution system in various streets during 1925, at $84,020.

Pa., Phila.—Mazzola & Marano, 709 S. 7th St., awarded contract by Dept. Pub. Wks. (Bureau of Water) for 2080 tons 16-24 inch cast iron pipe, at $283,565; N. Trotter & Co. 36 N. Front St. awarded contract for 30,000 lbs. piglead, at $4,850.

R. I., Providence—C. A. Haggerty, Webster, Mass., awarded contr. by Water Supply Bd. for about 1.6 miles 66 inch and 0.3 miles 48-in. steel pipe line with connections and appurts., at $306,-425.

S. C., Clinton—Geo. C. Odiorne awarded contract by Town for constr. of addition to raw water filtration plant, at $9,500. Town will expend $5,000 for laying 6-in. cast iron water pipe.

Tex., Galveston—Davis-Pace Co., Dallas, awarded contract for construction of reservoir on 58th St. and Ave. E, at $108,950.

Tex., Rising Star—Bucy & Son, awarded contract by Philipps Petroleum Co., Bartlesville, Okla., for lake, 1 mile long, one-half mile wide; will install pumping plant.

Tex., Waco—Hamm Drilling Co., Houston, awarded contract for drilling artesian well, at $22,-500.

Wis., Fond Du Lac—Jas. B. Clow & Sons Iron Co., 544 S. Franklin St., Chicago, Ill., awarded contract for furnishing 2500-ft. 4-in. pipe, $54.50 per ton and 3000-ft. 6-in. pipe, $50.50 per ton.

Wash., Seattle—The contract for installing water mains in W. Dravus St., let to Felix Arcorace, at $13,490.

Wash., Tacoma—Pacific Water Works Supply Co., Inc. Arcade Bldg. Seattle, awarded contract for furnishing 3000 ft. 6-in. Cl. B cast iron pipe; 960-ft. 4-in. Cl. C c. i. pipe; 3000 ft. 4-in. Cl. B c. i. pipe; 1000 ft. 6-in. Cl. C c. i. pipe; 480 ft. 6-in. Cl. D c. i. pipe; 1000 ft. 8-in. Cl. B c. i. pipe; 480 ft. 8-in. Cl. C c. i. pipe; 480-ft. 8-in. Cl. D c. i. pipe; 3400 ft. 18-in. Cl. B cast iron pipe; 2400 ft. 24-in. Cl. C c. i. pipe.

Prospective Work

ROADS AND STREETS

Ct., Westport—Construction of 7.1 mile bitum. macadam road (Danbury Rd. Cross Hwy., Long Lots Hwy.) being considered. Est. cost 250,000. J. A. McDonald, care State Hwy. Comn., State House, Hartford, Engr.

Fla., Blountstown—Calhoun Co. plans 20 miles beach drive along St. Joseph's Bay and 40 miles along gulf beach from St. Andrew's Bay.

Dade City, Fla.—Pasco County Commrs. plan impvt. of 27 roads totaling 125 miles. Election in April to vote on $1,330,000 bonds.

Fla., Ft. Pierce—St. Lucie Co. plans expending $50,000 for 7 miles 9-ft. bitum. macadam pavement and 15 miles grading; also 11 timber and pile bridges; contemplates over $1,000,000 road impvts., 100 mile waterbound macadam paving, surf. treated with asphaltic materials. E. H. Collins, Jr. Co. Engr.

Fla., So. Jacksonville—City plans to grade, pave, widen and improve streets and parks. $149,000 bonds voted. E. Jackson, Butler, Clk.

Ill., Aurora—Special assessment notice given for paving 7 streets here with Warrenite-Bitulithic.

Ill., Kewanee—Ord. providing for paving Prospect St.—Elliott to City limits; Franklin St.—Rose to Prospect Sts.; Fifth Ave.—Rose to Prospect Sts.; Grove—Prospect one blk. south—presented to City Council. Est. cost abt. $130,000.

Ill., Maywood—Edwin Hancock, 2047 Ogden Ave., Chicago, Cons. Engr. on paving contemplated on various sts. here. Est. cost $140,000.

Ill., McHenry—Town considering paving Main and Elm Sts., at est. cost of about $125,000. Bids prob. in March. Wells Engrg. Co. Engrs. Geneva, Ill.

Ind., Logansport—City considering paving various streets; abt. 46,393 sq. yds. Types: brick, sheet asph. rock asphalt, wd. blk. or concrete. Charles Lybrook, City Engr.

Ky., Paducah—City plans to expend $60,000 to $100,000 for hard surf. streets. Mayor J. N. Bailey.

Ky., Whitesburg—$200,000 bonds voted in Letcher County for completion of highway building.

Md., Baltimore—City—Howard W. Jackson, Mayor—plans several super-highways radiating from built-up section of City. Street north from 33rd St., dividing undeveloped territory betw. York and Hillen Rds. Steuart Purcell, Chf. Engr. Bernard L. Crozier, Hwys. Engr. Paving Commission, 214 E. Lexington St., will receive bids during April for red and granite blocks on concrete base; also plain cement on 32 sections of streets totaling 4 miles. Est. cost $300,000. Nathan L. Smith, Engr., 214 E. Lexington St.

Mich., Iron Mountain—Following work to be done in 1925: 6.5 mi. conc. surf. Waucedah Twp. S T L 12; 2½ m. conc. surf.—Quinnesec-Iron Mountain; 4½ mi. prob. grav. surf. bet. Sagola-Channing and Sagola-W. Co. line. Paul S. Israelson, Engr. Iron Mtn. F. F. Rogers, State Hwy. Commr. Lansing. Action soon on program. (Dickinson County).

Miss., Gulfport—Harrison County Bd. of Supervisors plans 105 miles of highways in Harrison County. Emile J. Adams, Pres. Will also build conc. bridge across Back Bay of Biloxi. $1,500,000 bonds voted.

Mo., Clayton—St. Louis Co. making prelim. plans for grading, bridging and paving 20 miles rd. from St. Charles Rock to Lemay Ferry roads, 18 ft. $200,000 to $600,000. R. Jablonsky, Clayton, Engr.

Mo., St. Louis—Bids will soon be asked for grading, draining and paving with Warrenite, sheet asphalt or Willite; 28,650 sq. yds. Kingshighway; Warrenite or conc. paving; 4950 sq. yds. on Rosedale St. Est. cost $100,400. W. W. Horner, City Engr., City Hall.

N. Y., Buffalo—May issue $200,000 bonds for widening various streets in City.

N. C., Wilson—$1,250,000 bonds voted by Wilson Co. for rd. and bridge bldg. W. J. Bokin, Co. Aud.

Ohio, Canton—Board of Control will receive bids in Spring for paving Walnut St. N. W. and 13th St. Est. cost $50,000. W. E. Sarver, City Engr.

O., Portsmouth—Resolution adopted for paving

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Kentucky Rock Asphalt Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Pierce-Arrow Motor Car Co.

Automobiles.
Ford Motor Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Brick, Paving.
National Paving Brick Mfrs. Assn.

Bridges.
Luten, Daniel B.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping
Littleford Brothers.
Pawling & Harnischfeger

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Gun Work.
Indiana Gunite & Const. Co.

Cement Testing.
Chicago Paving Laboratory.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chemists, Engineering
Chicago Paving Laboratory.
Dow & Smith.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Clay Pipe, Vitrified.
Clay Products Assn.

Clay Products.
Clay Products Assn.

Concrete Bridges.
Luten, Daniel B.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Rosing, Inc., Astrid S.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, Burdick & Howson.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Druar & Milinowski.
Flood, Walter H., & Co.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

with brick, conc. or bitum. surfacing, or resurfacing with sheet asphalt. J. Earl Chandler, Clk.

Pa., Connellsville—Election planned here to vote on $300,000 bonds for widening and surfacing Arch Street, etc. T. E. Hoensher, Connellsville, Engr.

Tenn., Union City—Obion Co. Commrs. plan hard surf. roads. Will vote in April on $1,000,000 bonds.

Tex., Angleton—Brazoria County will soon receive bids to surf. 2 roads: 10.88 miles shell and gravel State Hwy. 19—end of Sec. A at Bonnie to Ft. Bend Co. line; approx. cost $92,500; 6.59 miles St. Hwy. 19—Angleton to Bonnie. Est. cost $52,-500. H. E. Murison, Jr., Co. Engr. J. T. Loggins, Co. Judge.

Texas, Cuero—De Witt County plans paving Cuero-Westhoff rd. Est. cost $300,000. Stanley Kulawik, Co. Judge.

Tex., Gonzales—Gonzales Co. plans road through County. Est. cost $260,000.

Tex., Texas City—Board of Trade here interested in paving 6th St. including 11 blks. from Texas Ave. to 11th St. with concrete. Proposes $130,000 bond issue.

Wash., Olympia—State Highway Dept. contemplates following improvement work: Paving, 44.67 miles; surfacing, 6 miles; grading, 48.9 miles; grading and surfacing highways throughout State, 56.2 miles; 12 bridges, 3 abt. 1 mile in length and one, one-half mile in length; 1500 ft. bridge at Vantage Ferry. Highway bill signed by Gov. R. H. Hartley, providing $14,827,000 for highway work. J. Allen, State Hwy. Engr. Olympia.

W. Va., Clarksburg—Harrison County, Elk District, plans hard surf. road from Clark District line, Clarksburg, to Harrison and Barbour So. line. Considering bond issue in sum of $100,000.

Wis., Madison—Wisconsin Hwy. Commission advanced various 1926 projects to 1925 construction, due to passage of gasoline tax by Legislature, making available approximately $2,500,00 for 1925 road work.

SEWERAGE AND SEWAGE TREATMENT

Ark., Batesville—City plans constr. of san. sewers to cost $30,000. V. V. Long & Co. Engrs. 1300 Colcord Bldg. Okla. City, Okla.

Ark., Rogers—W. L. Winters, Merchants Bank Bldg. Fort Smith, Engr. Sewer Impvt. Dist. No. 8, will soon let contract for 3 miles sewer and sewage disposal plant. $35,000.

Ark., Smackover—City will probably expend $35,000 for sewer system here. For detailed information address City Council.

Cal., Beverly Hills—City will pay $144,000 to Los Angeles for privilege of making connection with latter's outfall sewer line.

Cal., La Habra—City has applied to Fullerton for contract to connect wtih Fullerton's outfall sewer system. W. C. Record, City Engr. Fullerton.

Cal., Los Angeles—Metropolitan sewer bond issue of $2,000,000 in Dist. No. 5, carried at election. Dist. includes Inglewood, Hawthorne, Lawndale, Lennox, Moneta and vicinity. Three dists., Nos. 1, 2 and 5—total of $9,120,000 in bonds—have voted for system. Steps will be taken to sell bonds that actual work may be started. Albert K. Warren, Sanitation and Drainage Engr.

Cal., Pomona—City will construct sewage disposal plant similar to one in use at Lodi. Est. cost $85,000. F. C. Froehde, City Engr.

Cal., Venice—Plans adopted by City for sewer in Rialto, Linden, Oakwood, Shell and Cestmore, Lincoln and Superba Aves., also certain other streets in northeast section of City. H. D. Chapman, City Engr.

Fla., Paimetto—City will construct $160,000 sewer system. P. P. Pilcher, Engr.

Ga., Atlanta—City Bond Commission approved contsr. of 2 sewers to cost $37,000; Confederate Ave. and in West End.

Iowa, Akins—Plans being made for san. sewer system, sewage disposal plant, etc. Bids about May 5. H. R. Green, 417 First Ave., Engr. Cedar Rapids. Est. cost abt. $20,000. W. A. Koster, Town Clk.

Ky., Paducah—City Commissioners plan construction of $1,000,000 san. lateral sewers and storm drains. E. R. Bradshaw, City Engr.

Ill., Crystal Lake—Ord. passed at recent meeting of City Council for installation of sewerage system in Leonard Manor and various other streets, including Maple Ave.

Ill., Jacksonville—Second ward sewer district impvt. has had public hearing. Prelim. plans prepared and general estimate of cost made of $265,-000.

Ia., Delmar—Will probably receive bids about May 1st for sewer system. Plans being made. Engr. Howard P. Green, Bever Bldg., Cedar Rapids. Jno. A. Fitzpatrick, Town Clk.

Ia., Iowa City—City considering constr. of sewage disposal plant. Est. cost $1,000,000. Engr. N. Barber, 228½ W. 4th St. Waterloo.

Md., Baltimore—City and Gold Dust Corporation, 65 Broadway, New York, and 5th Ave. near 22nd St. Canton, will construct trunk sewer in connection with proposed plant.

Minn., Albert Lea—Bids will be taken late this Summer or Fall for disposal plant. Est. cost abt. $75,000. C. J. Dudley, City Clk. Cons. Engrs. W. E. Buell & Co., 205 Davidson Bldg., Sioux City, Iowa, making plans. (Imhoff tanks).

Minn., Harmony—Will receive bids in Spring for sewer system here. Louis P. Wolff, 903 Globe Bldg., St. Paul, making plans. About $50,000. T. Sanderson, Vil. Clerk.

Minn., Le Sueur—Will probably take bids in Spring on san. and storm sewers. Louis P. Wolff, 903 Globe Bldg. St. Paul, making plans. Abt. $50,-000. A. A. Tambornino, City Clk.

Minn., Minneapolis—Columbia Heights sewer system contemplated. Will probably link sewerage system with that of City of Minneapolis. Meeting to be held soon to decide on issue. Carl Ilstrup, Sewer Engr., City Hall.

Minn., St. Paul—Resolution passed by City Council to construct 9-ft. sewer from Point Douglas Rd. to River. Est. cost $260,000. G. M. Shepard, City Engr.

S. C., Spartanburg—City contemplates issuing $75,000 sewer extension bonds. $75,000 incinerator.

Tenn., Knoxville—City Council has approved constr. of trunk line sewer in Lonsdale from Oakdale sewer. Est. cost $23,000.

Tex., Clarendon—City will vote in April on $121,-000 sewer bonds. F. E. Devlin, Engr., 614 Bitting Bldg. Wichita, Kans.

Tex., Crowell—City will construct sewer system at cost of abt. $50,000. F. E. Devlin, Engr., 614 Bitting Bldg., Wichita, Kans.

Tex., Dallas—Election in April to vote on $300,-000 bonds for san. sewers, $100,000 for storm sewers, $100,000 for incinerator, $250,000 for parks. Jno. C. Harris, Finance Commr.

Tex., San Angelo—Election in April to vote on $375,000 sewer bonds. E. F. Jackson, City Mgr.

Tex., San Antonio—$100,000 voted by City for constr. of one mile sewer ditch from City limits to Mitchell Lake. Jno. W. Tobin, Mayor.

Va., Clarendon—Capt. Jno. T. Talman, San Engr. Arlington Co., will soon begin constr. of trunk line sewer from Spout Run, dist. of 2 miles. Est. cost $27,000.

Va., Danville—City will probably vote on $100,-000 sewer bonds. A. M. Aiken, City Atty.

Va., Norfolk—City Council will soon ask bids for completion of sewer and drainage system in Fairmont Park, Douglas Park and Ballentine Pl. Est. cost $164,000.

W. Va., Huntington—City adopted specfs. and designs for sewer inlets and manholes, including head walls for pipe drains, manholes, etc. Plans to vote in May on $791,000 bonds.

WATER SUPPLY AND PURIFICATION

Ala., Albany—Alabama Water Co.—P. B. Hale. Mgr.—will install 300,000 gal. capy. tank for Albany-Decatur.

BUYERS' GUIDE

Deep Well Pumps.
Harris Air Pump Co.
Keystone Driller Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Dryers.
Cummer & Son, The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Machinery.
Westinghouse Electric & Mfg. Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Excavating Machinery.
Austin Machinery Corp.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co., Inc.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Gates, Sluice.
Coldwell-Wilcox Co.

Graders.
Austin-Western Road Machinery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gunite.
Indiana Gunite & Const. Co.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Mead-Morrison Mfg. Co.

Hot Mixers.
Austin Machinery Corp.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corp.
Koehring Co.
T. L. Smith Co.

Motor Fire Apparatus.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Duplex Truck Co.
Federal Motor Truck Co.
Ford Motor Co.
International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers, and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
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Paving Brick.
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Paving Joint Compound.
The Barrett Co.
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Paving Joint Filler.
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Pipe Cutters.
W. W. Strickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
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Pitch Filler.
The Barrett Co.
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Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

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Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Ala., Phenix City—$80,000 bonds voted here for water works.

Ariz., Chandler—Weiland Engineering Co. authorized to supervise construction of new Chandler water works system.

Ariz., Gilbert—Citizens considering plans for proposed water system. A. A. Weiland (of Weiland Engrg. Co.) preparing report on project.

Cal., Hemet—Council has authorized City Engr. Frank Stetson to prepare plans and specfs. for municipal domestic water system. Bond issue for $120,000 will probably be asked. It is probable that wells in the Valle Vista Dist. will furnish supply.

Cal., Los Angeles—Southern Counties Gas. Co. planning a 60-inch gas pipe line betw. Ventura and Glendale or Burbank to complete line from Long Beach to Santa Barbara. Est. cost $150,000.

Cal., Riverside—Government proposes to replace redwood water pipe system in March Field with cast iron system, involving 2-in. 4-in. and 6-in. mains. W. J. Anders, caretaker of field.

Cal., San Francisco—Thebo, Starr and Anderson, San Francisco, have applied to Federal Power Commission for permits to build a number of hydroelectric units along Speel river in Alaska, and three tributaries. Location of proposed plants will be some 30 miles southeast of Juneau.

Cal., Santa Barbara—$140,000 hydro-electric bond issue carried at recent election.

Fla., Okeechobee—City voted $110,000 water works bonds.

Fla., Tampa—J. L. McCall, J. A. Connor, 34th and Carter Ave., are interested in organizing stock company to establish water plant in Belmont Heights.

Fla., West Palm Beach—W. Palm Beach Water Co.—R. E. Dougherty, Supt.—will expend $250,000 for impvts. and extensions to distribution system; construct 2,000,000 gal. capy. standpipe.

Ga., Atlanta—Plans for City's new storage reservoir on Chattahoochee River will be made by Engr. Paul Norcross of Atlanta.

Ind., Alexandria—City officials here are planning to put City water consumers on meter payment system. Resolution passed authorizing water works committee to visit nearby towns having meter systems to investigate how system works.

Ind., Boonville—Test well sunk for Boonville water supply system recently has averaged 800 gals. a minute. Water will be piped 7 miles to City, according to present plans, and marks completion of first unit of the $200,000 water program inaugurated some time ago. Brossman & Company, Indianapolis, Cons. Engrs.

Ill., Hartford—Village Council here considering ord. that will provide for constr. of water works system for village. Est. cost abt. $80,000.

Ia., State Center—Plans being made for reservoir, pumping station, filtration plant and elevated tank. Brown & Cook, Ottumwa, Iowa. $50,000. H. M. Meads, Town Clerk.

Ky., Blackey—Blackey Water Co. will construct $10,000 extension to water works.

Fla., Dania—City considering expendt. of $75,000 for water works extensions. Henry T. Tubbs, Mayor.

Ky., Roxana—Dr. Gid Whittaker will construct $20,000 water works system.

Md., Fredericktown—City of Fredericktown will soon let contract for water works impvts. Est. cost $112,000. C. A. Haskins, Fredericktown, Engr., 517 Finance Bldg., City.

Md., Hagerstown—$200,000 bond issue will be sold May 1st by Hagerstown to finance start on constr. of filtration plant. (1st unit of new water works for City.) Two years will be required to complete entire new works which will cost about $1,500,000. When filtration plant is completed Water Comn. will begin laying pipes.

Md., Salisbury—Sewer and Water Commission acquired 53 acre tract for water works system. Bids will be asked in near future.

Mich., Marquette—Pearse, Greeley & Hansen, Chicago, Ill., Comn. Engrs. have completed survey of water works system here. Recommendations made that will call for expenditure of about $100,000.

Minn., Brainerd—City considering purchase of 1600 lin. ft. 6-in. cast iron and 2600 lin. ft. 8-in. pipe, 1 ton spcls. and 2 tons lead. Est. cost $6,500. Clk. E. T. Flemer.

Mo., Boonville—City Council will install two electric pumps at water works.

Mo., Kansas City—Raytown Water Company granted permission to lay water mains on 17 county roads.

Mo., Steele—$30,000 water works bonds voted here. A. C. Moore, Engr. 222 Industrial Bldg., Joplin.

N. C., Greensboro—City will expend $300,000 for water works, $200,000 for sewers, $200,000 for parks. Contemplate bond issue for electric lighting. E. G. Sherrill, City Clerk.

Okla., Lawton—$80,000 bonds voted for water works; will erect filtration plant, capy. 8,000,000 gals. H. G. Olmstead & Co., Engrs. 2230 W. 18th St., Oklahoma City.

Okla., Okmulgee—City Commission will probably expend $1,000,000 for bringing non-salty water from Salt Creek dam project. W. E. Carpenter, Commr.

Okla., Tulsa—Tulsa will vote in April on $500,000 water bonds. A. J. Rudd, Commr.

Ore., Eugene—R. E. Koon (Stevens & Koon) Portland, at work on survey of proposed pipe line to be installed by Eugene water board from McKenzie River brdg. to City. People will vote on bond issue in April to cover cost of project.

Tenn., Chattanooga—City Water Company considering expenditure of $300,000 for impvts. to water wk. plant; will install 15,000,000 gal. pump; six 1,000,000 gal. capy. concrete filters; will probably install auxiliary water plant on Signal Mountain. American Construction and Securities Co. Contrs. and Engrs. 50 Broad St. New York City.

Tex., Amarillo—$1,750,000 water works bonds voted here. Eugene Blasdel, Mayor.

Tex., Donna—H. J. Wilson, San Juan, preparing plans for water works system. $50,000 available.

Tex., Giddings—City voted $46,000 water and $45,000 sewer bonds. J. D. Fields, Mayor.

Tex., Goree—Douglas & Mitchell, Cons. Engrs., Wichita Falls, preparing plans for water works impvts.

Tex., Lometa—City (A. E. McLean, Mayor) voted $42,000 bonds for water works plant; construct 6, 8 and 4-inch pipe line; 100,000 gal. steel reservoir; install modern equipt.; will soon ask bids for machy. Cons. Engrs. Municipal Engrg. Co. Praetorian Bldg.

Texas, Mexia—City will expend $50,000 on new plant and extension; 1 pumping station, brick 24x40 ft.; 2,000,000 gals. capy.; install centrif. pumps, electrical drives, 3,000,000 gal. concrete reservoir, drill wells and lay 3 miles cast iron mains. $60,000.

Tex., O'Donnell—City will vote on bonds for water and sewer systems. $100,000. Lynn Co. Engrs.

Tex., Port Arthur—E. P. Dodge, H. F. Banker, Merchants State Bank Bldg., interested in water works system.

Tex., San Antonio—Election on $6,500,000 bonds for purchasing and improving water works, postponed until municipal ownership bill (now before legislature) has been passed. I. Ewig, City Engr.

Tex., Sinton—City has acquired artesian well and will erect 100,000 gal. concrete reservoir; install electrically driven pump.

Va., Pulaski—City considering impvts. to water system. D. H. Williamson, Water Engr. Mayor Calfee.

Va., Woodstock—Town will vote on $100,000 bonds for water supply system.

Wash., Olympia—Surveys being made by City Engr. Newell W. Avery for 10,000,000 gal. reservoir. Est. cost of constr. abt. $150,000.

Wash., Spokane—Total of $11,500 in water impvts. will be made by Modern Elec. Water Co. in Spokane Valley. 2 new pumps will be installed and additional stg. tank constructed.

Wash., Yakima—Citizens here in favor of municipal ownership of water system. Report provides for system costing approx. $1,385,000, including reservoir 4 miles west of town, capy. 16,000,000 gals. brought down from Oak Flats above jct. of Tieton and Naches rivers.

W. Va., Charleston—City Council has tentative plans for impvts. to water system on Capitol Hill.

W. Va., Ronceverte—City voted $100,000 bonds for water, paving and fire equipment.

Wis., La Crosse—Board of Public Works has been instructed to receive bids for portable pump for use with Water Department truck. M. Birnbaum, City Clerk.

BUYERS' GUIDE

Pumps.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

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Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.

Rock Asphalt.
Kentucky Rock Asphalt Co.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Scarifiers.
Austin-Western Road Machinery Co., The

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

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Truscon Steel Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Clay Products Assn.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Sewer Pipe Joint Compound.
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Dallmann Machine & Mfg. Co.
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Special Castings.
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Sprinklers.
Austin-Western Road Machinery Co., The

Steam Shovels.
Keystone Driller Co.

Steel Joists, Studs and Sash.
Truscon Steel Co.

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Lighting.
Holophane Glass Co.
Westinghouse Electric & Mfg. Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch.
The Barrett Co.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Best Tractor Co., C. L.
Ford Motor Co.
Holt Mfg. Co., Inc.

Transmission, Truck.
Warford Corp.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck.
The Hug Co.

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Clay Products Assn.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.
Stewart, W. H.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Carey Co., Philip.
Pioneer Asphalt Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
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—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
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—Industrial Track
—Manhole Covers
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—Road Planes
—Road Plows
—Road Rollers
—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
—Scrapers, Power
—Sheet Piling, Steel
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
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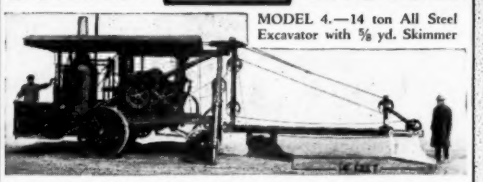

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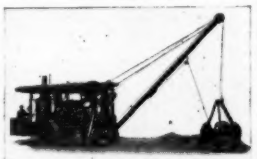

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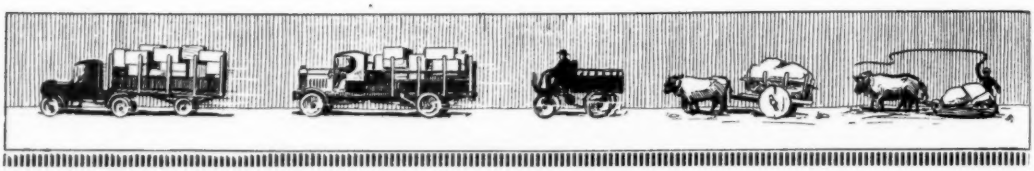

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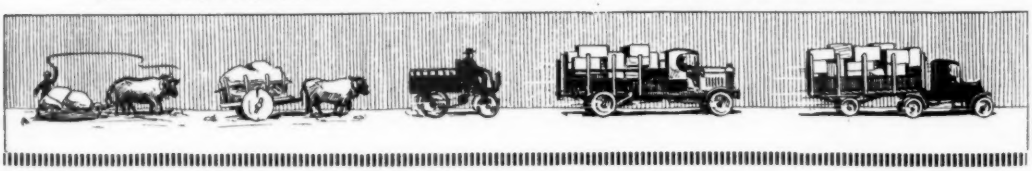

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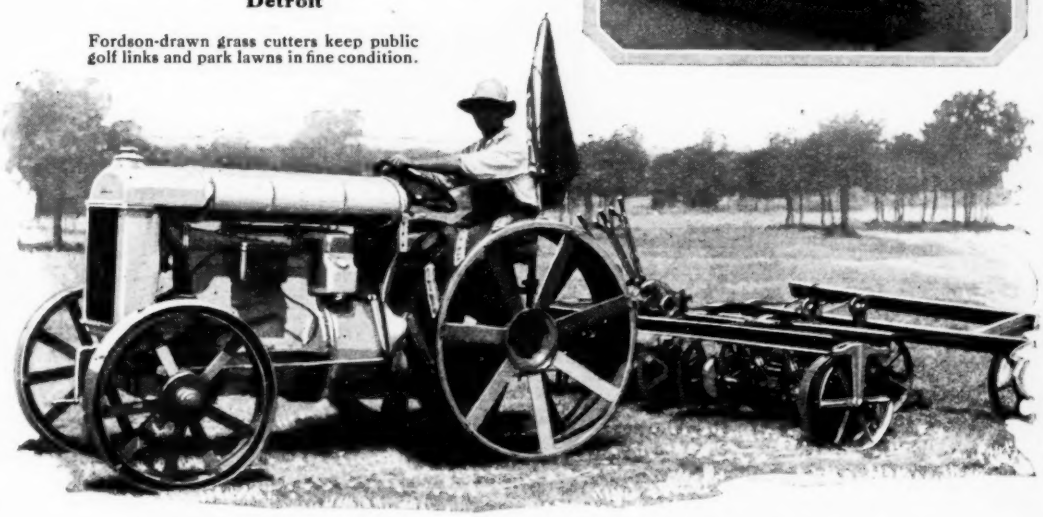

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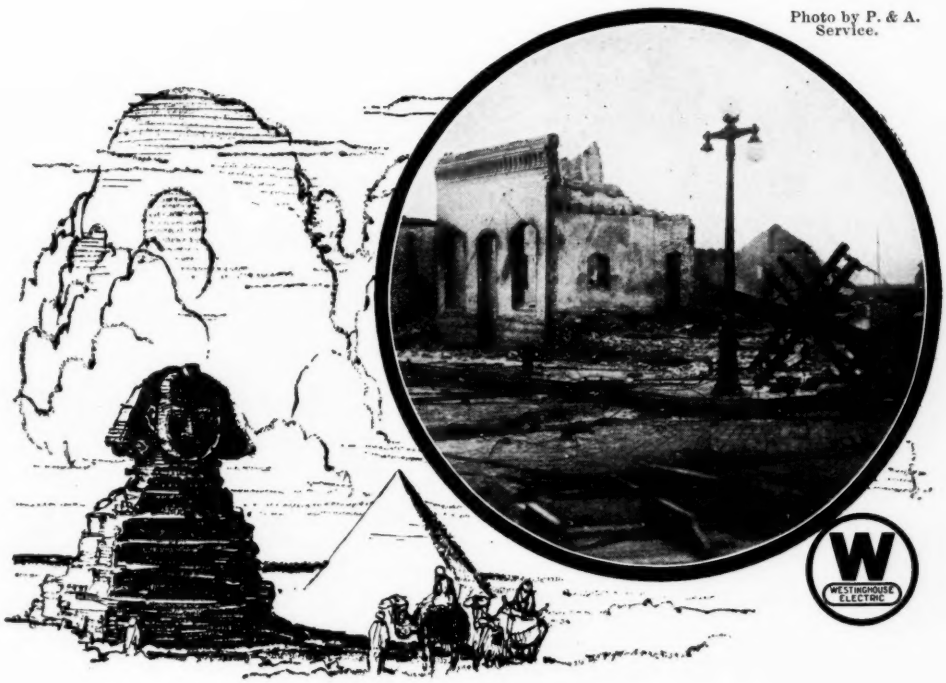

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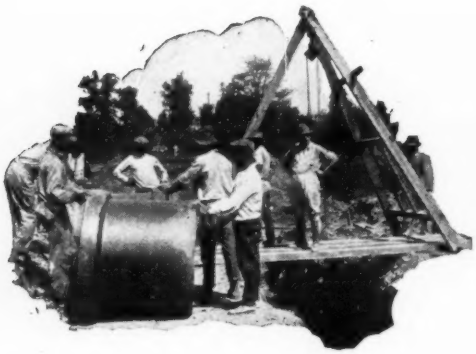

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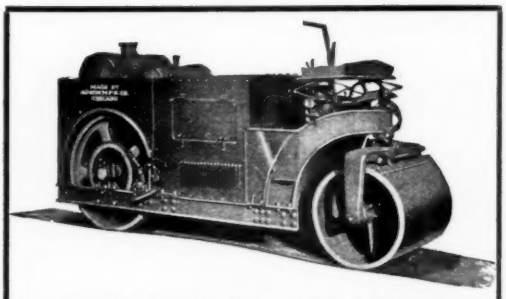

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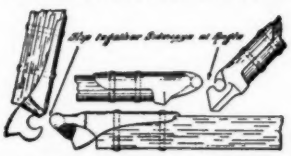

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CITY PLANNING AND THE AUTOMOBILE

By Alvan Macauley, President, Packard Motor Car Co., Detroit, Mich.

Last spring the writer made a survey by gathering first-hand information from the city engineers of some two hundred and thirty municipalities of various sizes over 10,000 population. Nobody would have expected to find such a prevailing feeling of pessimism among technical officials as was expressed in the data submitted—or such a record of inadequacy in real activity.

Traffic Problem Most Acute

There is little doubt, after studying this material, that the traffic problem is the most acute and difficult one with which the cities have at present to contend. Water supply, sewerage, street paving—these are comparatively simple and their technique has been worked out and, if a city is willing to pay, it can solve these problems definitely and continuously. Even "crime waves" can be stemmed and public health can be bought. But in many cities only the utmost intelligence, effort and expenditures can be of substantial help in the traffic situation. And, in a few years, if they are not available soon, even unlimited planning, action and money will not avail.

The outstanding fact revealed is that the important traffic streets of a large proportion of the 233 cities studied are inadequate for either the moving traffic or stationary vehicles which must use them. The engineers of some cities feel that this fundamental difficulty is due to the automobile; the engineers of more cities feel that the difficulty is due to the street and, fortunately, most feel that it is a problem which challenges their engineering skill and which must be solved.

Conditions Disclosed

There is no logical relation between the width of important streets and traffic use of them in the majority of the two hundred-odd cities and this situation is particularly true of the older and smaller cities. In less than a quarter of the cities are the business streets wider than the main thoroughfares; in three eighths the business streets are equal in width to the main thoroughfares and in the remaining three-eighths the business streets are narrower. In most of the cities the streets are utterly inadequate to provide parking space where it is most needed. Already nearly a third of the cities have widened some of their streets in order to accommodate traffic, and in fully a half, traffic has become congested to such a degree that widening of streets involving enormous expenditures is now urgent.

What these conditions mean in accidents, transportation, cost of living, inconvenience, extra policing and many other economic and social burdens, cannot be estimated. These burdens comprise a congestion tax, which is borne by every citizen and which increases rapidly each year until it is further augmented by the cost of street widening. What are the cities doing to relieve themselves of these burdens?

It seems, in many ways, unfortunate that cities in this country became interested in city planning when they did—a little too early—a few years before the traffic problem became acute. If the interest in city planning had arisen simultaneously with the pressure of traffic congestion, the whole city planning movement would have been more powerful and effective. Its inspiration would have been the city practical rather than the "city beautiful." And if it had not been that traffic regulation by policing was so simple and apparently successful in the earlier stages of the traffic problem, it would have been realized sooner that regulation is only a temporary palliative, not a cure.

Are City Plans Taken Seriously?

These reasons are at least partially responsible for the fact that, while about half the cities report planning commissions, very few have taken these commissions and their plans with any degree of seriousness. They also account for the fact that, while about a third of the cities have made some study of traffic conditions, very few have used traffic studies in planning street layout, and only about a fifth have any kind of plan for future development.

Causes of Traffic Congestion

The city engineers who replied to the questionnaire named thirty or forty causes of traffic congestion and almost as many remedies. No doubt if their proposals were carried out, traffic congestion would in a number of cases be measurably relieved. Street widening, enlarging intersections, separating grades, lengthening curb radii at corners, removing obstructions to vision, better pavements, better maintenance—such remedies as these would certainly save hundreds of

streets in the country from becoming intolerably congested. So also would regulatory measures such as the establishing of one-way streets, segregating different types of traffic, by-passing through traffic, prohibiting hazardous turns, signal systems and public education in traffic laws. So also would provision for parking—although the parking problem in the busier streets of the older cities is most difficult of solution because of the high land values which prevail.

But how inadequate such measures are, only the larger cities know. They discuss instead the need for more parallel through streets, for radial streets, for new streets connecting sections, for more rapid transit, for zoning, for limiting building heights, for decentralizing the population—for wholesale replanning and rebuilding, which probably are much nearer the fundamental needs. The smaller cities can still prevent the conditions which must otherwise be inevitable, by making full use of the experience gained by the larger cities. It is cheaper and easier to plan than replan, to build than to rebuild.

A Local Problem.

After all, the traffic problem is a local one. It will handicap further work if the man in the street and the man in the automobile—as well as the man in the city hall—feels that somehow, by some black magic or White House magic, his traffic problem will solve itself.

Thinking down to the bottom, we realize that congestion will not be remedied until every automobile owner accepts it as his problem—just as much his own problem as his license or a leaking radiator on his car. And before that, every automobile dealer should accept it as his problem. And before that, every automobile manufacturer should accept it as his problem.

A Sense of Personal Responsibility

If we each of us realize it as our own individual problem we shall feel it our duty to work together for its solution.

It does not seem credible that the automobile industry and the automobile owner should have failed to learn the obvious lesson from the burdensome tangle of restrictive legislation which now surrounds them.

As traffic congestion grows, regulation and restriction increases.

When the cities were confronted with growing traffic problems a few years ago, the police departments assumed charge. The congestion was slight compared to what it is now and regulatory measures were simple—and seemingly effective. In most cases, while the engineers feel that the traffic problem is really an engineering problem, they find that it is still in the hands of the police department. Traffic rules, one-way streets, signal towers—they worked at the beginning, and apparently the prevailing theory is that as traffic congestion increases, all that is needed is simply more rules, more one-way streets and more signal towers—and bigger traffic courts.

The police officials and their advisors in many of the larger cities have used commendable ingenuity and patience in untying traffic tangles and inventing schemes for preventing them. But the end of such measures is near—what is now needed is engineering ability and not police power.

The automobile industry need have little fear that regulation will go "beyond the limit." The big cities probably will never forbid the use of automobiles in congested sections—they will not have to. Already the New York subways are urging automobile owners, through advertising, to park their cars out of the theatre and shopping centers and go downtown by train. As a matter of fact, many motorists have been doing that for months.

When the cities and their traffic commissions begin to find that the traffic problem cannot be solved by putting drivers in jail, they will turn their attention to the streets.

Need for Better Streets

It must be admitted that we—the automobile industry—have been so concerned with "next year's model" that we have forgotten that it would have to run on last generation's streets—and generally on streets built on the 1682 model—when William Penn laid out the first checkerboard street plan for Philadelphia. We have been so busy boosting highways to take a man from one city to another that we have given no thought to what happens when he gets there. But now we must add to the slogan of "Good Roads" one of "Better Streets."

It might be said, with justice, that the development of the automobile was too rapid to be foreseen and adequate provision made. But how many cities have adequately foreseen, planned and provided for their growth in other ways besides automobile traffic? To point out that the great majority of the cities have

grown up without adequate vision or conscious guidance is commonplace. It is for this reason that the automobile industry and the automobile user should not be expected to accept responsibility for the existence of the present situation. But they certainly should and must accept partial responsibility for its relief.

Are City Engineers Pessimists?

With adequate funds and public support the city engineers of the larger cities could eliminate the most serious traffic difficulties—at least for some years. In the smaller cities they could probably prevent them altogether. The number and use of automobiles will undoubtedly continue to grow but probably all the general types of traffic congestion and their causes have already been or can be studied and solutions for them worked out. If he had the means and the power, the engineer of any city of any size and type could know what he faces in traffic problems and could prevent them to a considerable degree. This does not mean to infer that all that can be known of city planning and traffic control is known and that engineering skill has solved all the possible problems—there is still much to be learned and much to be solved. But much more would be learned and solved if it were not for the pervading sense of hopeless pessimism with which so many technical officials face their problems. While the country boasts (with justification) of its sixteen or seventeen million automobiles as proof of happy prosperity, it should not forget that this prosperity requires intelligent control.

Citizens and their elected officials generally lag behind the municipal engineers in matters of city development—and, quite naturally, perhaps it will always be so, as the physical growth of a city generally precedes its civic growth. That is why the solution of many traffic problems is still in the thinking rather than in the acting stage. The city beautiful idea appealed to civic pride, it is true, but civic pride only infrequently arouses itself to more than lip service in the cause of civic beauty. Fortunately, however, all the economic interests of a city can be appealed to on its practical needs. Certainly the man in the automobile as well as the man in the street can understand the need of improving traffic conditions and a city plan on which to base such improvements.

A Planning Commission for Every City

Every city, large and small, needs a planning commission—with not only a planning function but also a realizing function. And on this commission there should be representatives of all the interests concerned—and men who can arouse such interests. Not only should the mayor, the council's head, the city engineer, the superintendent of streets, and the police chief be active members, but also should representatives of civic organizations, of automobile dealers and of automobile users. Public interest should be awakened and continuously maintained until adequate provision is made for correcting any conditions which cause trouble. When the engineer has worked out a plan to relieve congestion at some particular point that plan should be "sold" to the public—even to the extent, if necessary, of having the traffic policeman at that particular point distribute explanations of the plan and petitions to all motorists inconvenienced.

In intelligent city planning and conscious control of city development lies the principal hope of preventing and ameliorating the traffic difficulties of the future.

Zoning

Zoning must be organized not only with regard to use and to the comfort of the people but also with regard to the transportation necessities of the various sections. Zoning regulations have been devised and enforced to prevent the haphazard jumbling of various types of buildings and their uses—and they can also be made to prevent traffic concentration and mixing of different types of traffic. We know the social and economic relations between the zones and we therefore can know the traffic relations. We know that there will be a flow of traffic between residential and business, shopping and amusement centers at certain times of the day; between railroads and shipping terminals and manufacturing and wholesale distributing zones; and that there will be a constant flow of through traffic along the most convenient streets connecting with popular highways. All these needs can be, to a large extent, foreseen—and if there is a civic will, provided for.

If tall buildings and population congestion are a cause of traffic congestion, then building heights should be restricted. If certain zones become overgrown, subsidiary decentralized zones must be developed. Such control does not necessarily mean exercise of the

police power of the municipality—enlightened cooperative citizen action can bring it about. The success of the "Save New York" movement in keeping manufacturing establishments out of the high class retail district demonstrates what can be done. The city can guide its growth in many ways without abusing its powers.

The traffic problem is, therefore, but a part of the larger civic problem of city planning. Knowledge, vision and will are needed—the first two can be provided by the engineer, the architect and the practical sociologist—the last can be provided only by the citizen.

The foregoing paper by Mr. Macauley was read at the International Town, City and Regional Planning Conference on April 20, 1925.

PROPOSED CAUSEWAY BETWEEN ROCKAWAY BEACH AND SANDY HOOK, N. Y.

By William J. Wilgus, 233 Broadway, New York, N. Y.

A cursory glance at the geography of New York and its environs at once reveals the grave difficulties that beset those who plan for its future. Great rivers and bays divorce its island boroughs from each other and from the mainland and grievously hinder, if not prevent, the application of two of the underlying principles of modern city planning—decentralization of population and by-passing of traffic at centers of congestion.

Fully to appreciate this situation it should be realized that within some forty years the anticipated population of the region will number upward of twenty millions. Of these it is expected that thirteen millions will reside in the northeast or New York sector lying east and north of the Hudson river; five millions in the northwest or upper New Jersey sector embracing Newark, Bayonne, Jersey City, Paterson, Passaic, Hoboken and lesser communities; and two millions in the southwest or lower New Jersey sector including Monmouth, Middlesex and Union counties, N. J., and Richmond County, N. Y. The southeast sector, uninhabitable, lies in the Atlantic Ocean.

Inter-communication between the northeast and northwest sectors, though hampered by the Hudson River, at least is direct, but the case is not so simple with movements between the northeast and southwest sectors. There, under existing conditions, it is necessary for traffic not only to cross the North or Hudson River, but also to traverse important sections of the northwest sector with which it has no concern.

This means that unless some more direct route is established between the northeast and southwest sectors of the region—communities to number 13,000,000 and 2,000,000 respectively within 40 years—the huge traffic between them must be provided for at enormously costly crossings of the East and North rivers and the tributaries of Newark Bay and along the New Jersey streets and highways that lie outside of those sectors.

It will readily be seen that this circuitous routing involves stupendous expenditures for bridges, tunnels and thoroughfares, delays to the inter-sector travel and congestion amidst the intermediate localities to which this foreign traffic will be a curse rather than a blessing.

The question, therefore, naturally arises—is it not possible in some way to create a direct connection between the northeast and southwest sectors so as to by-pass the northwest sector and escape the East River and North River crossings for the larger share of this inter-sector movement. Fig. 1 shows graphically how needful is the cross-connection in order that the wide detour may be saved.

In seeking a shorter pathway between the northeast and southwest sectors another need becomes apparent, namely, increased facilities for sea-bathing and other recreations that should be conveniently near the mighty population of some fifteen millions that will occupy the portions of the region directly bordering on the sea. No effort can be too great that will afford this multitude plenty of nearby room for health-giving amusement.

Then there is the need for a breakwater in Lower Bay—the apex of the southeast sector—for the triple purpose of protecting (a) the northerly shores of New Jersey and easterly shores of Staten Island from ocean storms; (b) barge canal operation between Upper and Jamaica bays, and (c) the ship channel entrance to Jamaica Bay. The constant silting up of the latter is a real danger, as Rockaway Beach for the past century has been progressing westward at the average rate of over a city block per annum.

It is evident then that there are pressing needs for a direct connection between Long Island and the mainland of New Jersey for the triple purpose of rail and highway access, bathing beach expansion and harbor protection.

With these needs so glaringly apparent it behooves us whole-heartedly to inquire into the possibility of discovering means of accomplishing the purpose.

made by nature is not beyond the bounds of practicability.

The force of ocean waves against a barrier of this kind is, of course, not to be treated with scorn; but experience at Long Beach, Rockaway Beach, Coney Island, and elsewhere demonstrates beyond peradventure that danger from that source may be avoided if a sufficiently flat slope is employed upon which the waves may gradually expend their force. In doing this, the very flatness of the slope on the ocean side of the causeway will produce some 8 miles or more of additional bathing beach.

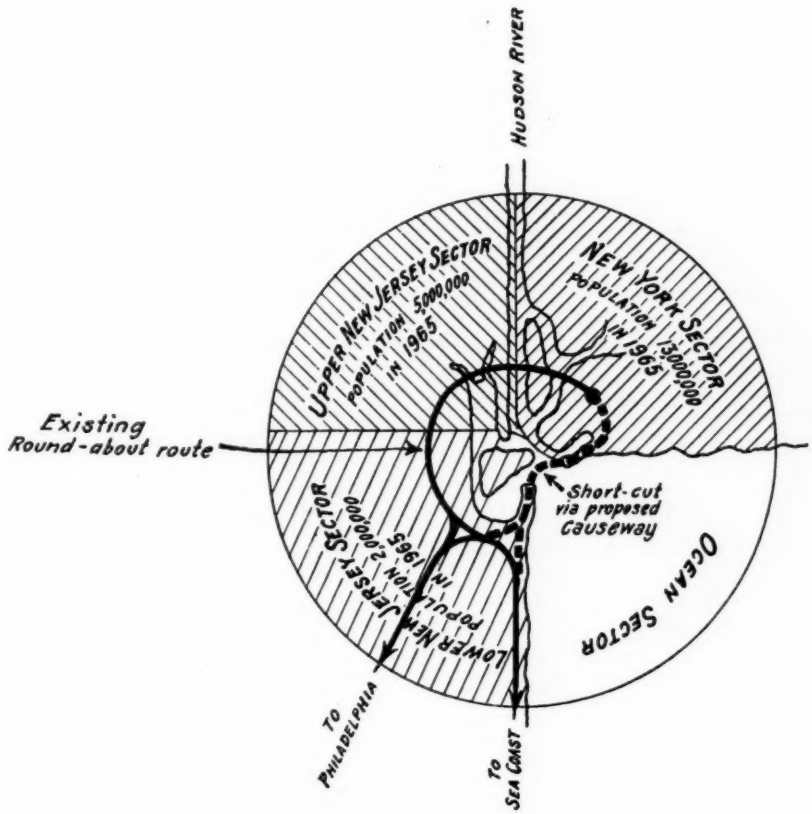

FIG. 1—DIAGRAM SHOWING HOW PROPOSED CAUSEWAY WOULD SAVE LONG DETOUR.

An inspection of the Coast & Geodetic Survey chart shows that the 8-mile stretch of ocean between Rockaway Beach and Sandy Hook really is not such an obstacle to a connection between those points as would appear from a glance at the surface of the sea on a stormy day. In the main it is shallow water, the average depth of which is only from 18 to 20 ft. The filling of a causeway between the tips of the land projections already

In addition to the bathing beach a boulevard is proposed, 110 ft. in width (an 80-ft. driveway and two 15-ft. sidewalks); also a commercial strip of made-land 100 ft. wide facing the boulevard and ocean; also a sufficient space on the

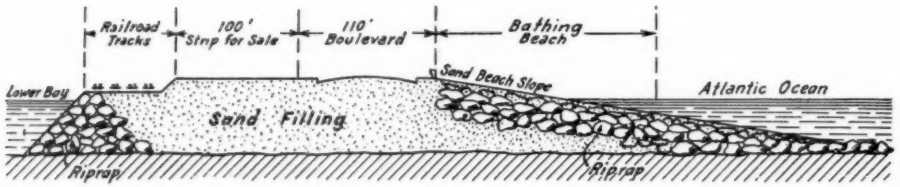

FIG. 2—SKETCH OF CROSS SECTION OF PROPOSED CAUSEWAY.

side facing the bay for four railroad tracks, two for through service and two for commuter and rapid transit service. The boulevard and railroad tracks would be carried under the entrance channel by tunnels constructed by the method used at Detroit but varied therefrom, in the interest of economy, to meet this peculiar situation.

An idea as to the cross-section of such a causeway is sketched in Fig. 2.

The required width of the ship channel and waterway in such a causeway is a subject for the most careful investigation of tidal currents and tidal flow throughout the entire port. For purposes of preliminary study a width of 4,500 ft. is being used; this is in excess of the existing opening at the Narrows. On each side of the opening a monument of majestic proportions is proposed to mark the entrance to the Nation's leading gateway and at the same time serve as a lighthouse and as a ventilating shaft for the tunnels beneath.

The diagram in Fig. 3 illustrates the proposed treatment of the entrance.

The materials for this great fill would come from the excavations of government channel widenings and deepenings, and from new tunnel construction in New York and its environs—materials which otherwise perforce will be towed and dumped at sea some five miles beyond this site. Rock fill would be used for the exterior mounds and sand for the interior filling and top dressings.

In this way, through the utilization of waste products, the entire cost of the project should not be greatly in excess of that of the subaqueous tunnels. As an offset to this comparatively moderate cost there are (1) the value of the new beach, (2) the value of the made-land to be devoted to commercial purposes, (3) the enhancement in the value of the three-quarter million acres of most attractive land in Monmouth, Middlesex, Union and Somerset counties in New Jersey that will thus be put in convenient touch with Greater New York, (4) the tolls to be derived from the railroad tracks and boulevard, and (5) the savings effected at the East and North river crossings and along the thoroughfares in New Jer-

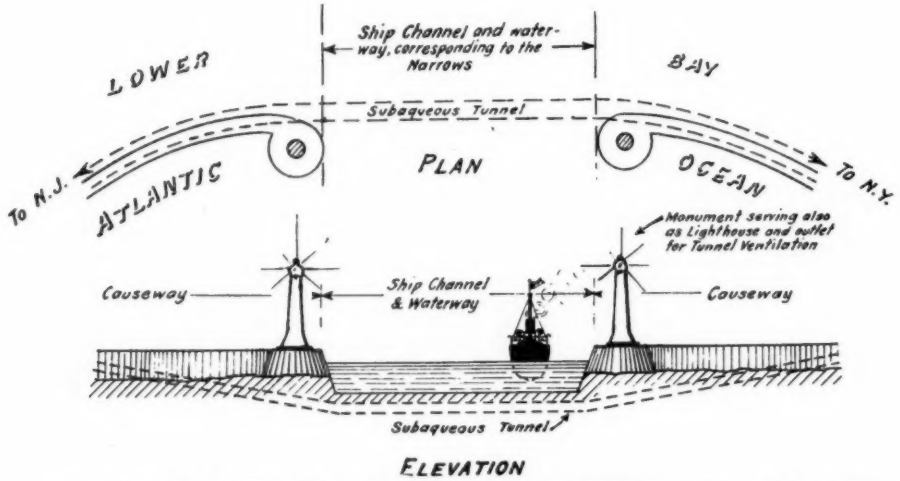

FIG. 3—DIAGRAM ILLUSTRATING PROPOSED TREATMENT OF CAUSEWAY ENTRANCE.

sey, due to the diversion therefrom of this inter-sector traffic.

It will be seen that in the interest of decentralization of population, by-passing of traffic. savings of cost, protection of channels and harbor, and bathing beach expansion, a link is urgently required between the two horns already created by Nature, known as Rockaway Beach and Sandy Hook; and that, properly planned, such a giant causeway has excellent prospects of being proven both physically and economically practicable. The needs certainly are so compelling as to warrant a sympathetic detail inquiry before dismissing the dream as unrealizable.

Should the outcome of such an investigation be adverse to the project there will at least be comfort in the knowledge that a tentative plan for the achievement of a highly desirable end has not been lightly set aside.

HIGH POINTS OF NEW JOINT COMMITTEE REPORT ON CONCRETE

By Norman M. Stineman, Structural Engineer, Portland Cement Association, 111 W. Washington St., Chicago, Ill.

The new Joint Committee Report on Concrete, dated August 14, 1924, has been published under the full title of "Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete."

This report was prepared by affiliated committees of the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the American Concrete Institute and the Portland Cement Association. This is the same group of national organizations that sponsored the old Joint Committee Report known as the "Final Report of the Joint Committee on Concrete and Reinforced Concrete," dated July 1, 1916. These two publications are more commonly referred to as the old Joint Committee Report and the new Joint Committee Report.

Both reports are the result of years of labor of 25 or 30 engineers of national reputation. Their work was first issued in the form of a preliminary report in 1908. From that time forward the successive Joint Committee Reports have been quite generally accepted as the best authority on reinforced concrete design and construction. A revised report was issued in 1912, and the so-called Final Report in 1916. The members of that committee realized that they had by no means given out the last word in the design and construction of reinforced concrete. The committee members felt, however, that it was time for them to bring their work to a close. They expressed the hope that when further investigation and experience required it, some new body of men could take up the work of revision.

The final report of the old Joint Committee was not long in existence before new developments in the art of making concrete demanded attention. This was true in particular with respect to knowledge obtained on the influence of proper proportioning, on the harmful effect of excessive mixing water in concrete, on the importance of proper grading of aggregates, on the injurious effect of organic impurities in sand, on the value of thorough curing, on precautions necessary in concrete work during cold weather, and on measures required to prevent damage by alkali and sea-water. Other developments indicated that maximum shear values might be higher than had been supposed.

It was in June. 1917, almost exactly a year after the adoption of the final report of the old Joint Committee, that the American Society for Testing Materials took the initiative in bringing about the appointment of a new Joint Committee to consider these further developments. War and post-war conditions prevented immediate action, so that it was not until February, 1920, that the new Joint Committee was finally organized, with a membership of 23 engineers, several of whom served on the previous committee.

The new Joint Committee issued a progress report under date of June 4, 1921, and a completed report dated August 14, 1924.

In its purpose the new report differs somewhat from the old Joint Committee report of 1916. The old report specifically states that it is not a specification but may be used as a basis for a specification. The new report of 1924 is admittedly a specification intended to cover the general conditions affecting the design and use of concrete and reinforced concrete.

The new specification is not in building code form. It could not be incorpo-

rated bodily in a building code as a separate chapter on concrete and reinforced concrete. Its recommendations could be incorporated, but not its actual text. It will be of interest to building officials to know that a committee of the American Concrete Institute, some of whose members were members also of the Joint Committee, is now preparing a proposed building regulation covering concrete and reinforced concrete which will be based on the new Joint Committee report, but will be written in building code language. When completed, it can be incorporated as a separate chapter in a general city building code. The first progress report of this committee will appear in the proceedings of the American Concrete Institute to be issued in June, 1925. It will be of great assistance to progressive building officials who like to keep their codes in line with engineering practice, but lack the necessary time to make a thorough analysis of the new Joint Committee report.

Working Stresses

In the new Joint Committee report, as in the old, allowable working stresses in concrete are directly proportional to the crushing strength of the material at the age of 28 days. In general, the working stresses are somewhat higher than in the old report of 1916. This change is fully justified in view of the definite advances made in the control of the quality of concrete in the field. This I will discuss later.

The allowable direct compression in concrete in piers and pedestals whose length is not more than three times the least dimension is 25 per cent of the crushing strength at the age of 28 days.

The allowable direct compression on the entire net area of concrete in columns reinforced with longitudinal bars and separate lateral ties is placed at a maximum of 20 per cent of the crushing strength at 28 days. Allowable compression on the concrete in the circular core of a spirally reinforced column is a variable quantity depending on the ultimate crushing strength of the concrete at the age of 28 days, as before, but depending also on the percentage of longitudinal reinforcement, and on the percentage of spiral steel. A column having an unsupported length of more than 40 times the least radius of gyration must have the permissible stresses reduced in accordance with a formula given in Section 170.

The permissible extreme fibre stress in concrete in members under bending stress is placed at 40 per cent of the crushing strength at the age of 28 days in ordinary cases, and 45 per cent immediately adjacent to the supports of continuous beams.

If some of these allowable stresses seem to be high, your attention is invited to the fact that, in the first place, all these percentages are based on the strength of the concrete at the age of 28 days. The strength will of course increase quite rapidly for several months longer. Then, as regards the allowable stress in bending, the maximum occurs only at the extreme edge of the member. It decreases rapidly to zero at the neutral axis. Concrete of a given strength will show an extreme fibre strength in flexure of about 1.6 times the strength under direct compression. In other words, if a sample of concrete tests 2,000 lbs. per sq. in. in direct compression, the same material placed in a reinforced concrete beam could be expected to have an extreme fibre strength of about 3,200 lbs. per sq. in. Consideration of this fact, in conjunction with the rapid increase in strength for several months beyond the 28-day period, should convince anyone that the working stresses recommended in the Joint Committee report are sufficiently conservative.

The maximum shear in beams, under the most favorable conditions, where the longitudinal steel at both top and bottom, as well as the web steel, is anchored mechanically or by means of hooks, may be 12 per cent of the ultimate crushing strength of the concrete, as against 6 per cent in the old Joint Committee report. This does not mean that the shear reinforcement will be stressed to twice the amount permitted by the old report. It does mean that the total end shear may be double the amount sanctioned by the old report, although it naturally follows that about double the amount of shear reinforcement will be required in the extreme case.

Investigations and tests conducted by the U. S. Bureau of Standards were largely responsible for the revision of previous practice pertaining to shear.

As to steel reinforcement, the new Joint Committee report sanctions the use of both billet-steel and rail-steel bars, and of cold-drawn steel wire. Billet-steel bars of structural grade and light structural steel shapes used as concrete reinforcement are allowed 16,000 lbs. per sq.

in. Billet-steel bars of the intermediate and hard grades, rail-steel bars and cold-drawn steel wire are allowed 18,000 lbs. per sq. in. Provision is made also for the consideration of stress in both concrete and steel in composite columns of reinforced concrete and structural steel. The same is true of columns of reinforced concrete with cast-iron cores.

Field Control of Concrete

The control of the quality of concrete in the field has been given a definite impetus by the Joint Committee report. The committee itself sponsored a series of field tests carried out under the auspices of the Joint Committee of Contractors, on which the Associated General Contractors of America were represented, with the object of determining the practicability of maintaining control of the quality of concrete in the field under actual construction conditions. These field tests fully justified the Joint Committee recommendations.

The engineering and construction departments of certain railways have likewise taken the initiative in developing field practice for the control of the quality of concrete on actual construction work. Notable among them are the Big Four, the Central R. R. of New Jersey, the Pennsylvania Lines, both east and west, the New York Central, the Canadian National, the Northern Pacific, the Santa Fe and the Louisville & Nashville. They have proved to their own satisfaction that the production of quality concrete under actual construction conditions is beyond the experimental stage. It can now be said to be an accomplished fact.

This means, of course, that the old nominal mixtures of 1:2:4, 1:1½:3, and so on, must go by the board. They must give way to 1:6 and 1:4½, so as to permit the proper ratio between fine and coarse aggregates, whatever ratio may be necessary to produce the densest mixture for the materials in question. This means also that it is possible to predetermine the strength of concrete after a study of the materials to be used. The method followed in making this study is so simple that it can easily be carried out on the work in advance of construction and checked up as the construction proceeds.

Aggregates

The aggregates permitted for use are no longer confined to sand, gravel and stone. Whereas, the old Joint Committee report defines fine aggregate as sand or the screenings of gravel or crushed stone, the new report defines it as "sand or other approved inert materials." The old report defines coarse aggregate as gravel or crushed stone. The use of blast furnace slag actually is frowned upon. The new Joint Committee report defines coarse aggregate as crushed stone, gravel or other approved inert materials with similar characteristics, or combinations thereof, having clean, hard, strong, durable, uncoated particles free from injurious amounts of soft, friable, elongated or laminated pieces, alkali, organic or other harmful matter. Consequently with regard to both fine and coarse aggregates, the new report sanctions the use of any material that has been found suitable, whether such materials are crushed stone, gravel, blast furnace slag, steam-boiler cinders, chats, crushed brick-bats, or any other suitable material locally available.

Mixing

The new Joint Committee report recommends definite measurements of fine and coarse aggregate and definite control of the quantity of mixing water to be used in each batch, so that the concrete will not only be of high quality, but of uniform quality as well. The minimum time for mixing is placed at one minute. The quantity of water used must be the minimum necessary to produce concrete of a workable consistency.

The consistency must be checked from time to time, either by the slump test or by some other known means.

Batch mixers must be used and must be equipped with charging hoppers, water storage and a water-measuring device controlled from a case which can be kept locked and so constructed that the water can be discharged only while the mixer is being charged. The mixer must also be equipped with an attachment for automatically locking the discharge lever until the batch has been mixed the required length of time after all materials are in.

Hand-mixing is of course authorized in special cases where the quantity of concrete is small or where the strength is of comparatively little importance.

Placing

The chuting of concrete is not entirely condemned, but the slope of the chute must be sufficiently steep so that the concrete will move along the chute without separation of the ingredients. The

trouble with most chuting systems is that the slope is too flat. Such a system of distribution requires an extremely wet mixture of concrete to keep up the flow, with a consequent reduction in strength.

Protection Against Heat and Cold

Very definite recommendations are made in regard to protection against premature drying out in hot weather, or against freezing in cold weather. During hot weather exposed surfaces shall be protected for a period of at least 7 days after the concrete is deposited. In cold weather concrete shall have a temperature at the point of deposit of not less than 40 deg. F. nor more than 120 deg. Provision must be made for maintaining the concrete at a temperature of at least 50 deg. F. for not less than 72 hours after it has been deposited. The reason for this minimum temperature of 50 deg. arises from the fact that concrete sets very slowly when the temperature is less than 40 degs. F. At 50 degs. the setting process is quite normal. The minimum temperature has therefore been placed at 50 degs. in order to keep it at a point where the hardening process will make normal progress.

Salt, chemicals or other foreign materials, when added to concrete, shall under no circumstances be considered as a substitute for protection against freezing. The danger in the use of salts, advertised commercially as non-freezing solutions, lies in the tendency of a careless construction foreman to consider them as substitutes for protection against freezing. He is likely to take it for granted that they will answer the purpose and that nothing more need be done. He overlooks the fact that concrete sets very slowly when the temperature is as low as 40 degs. F., and not at all when it reaches the freezing point. Even though a chemical product may prevent actual freezing down to a temperature of 20 or 25 degs., the concrete will not harden at such temperatures.

Design

Certain phases of design practice are worth mentioning here. For the purpose of design, the span length of a freely supported beam or slab shall be the distance between centers of supports, but need not exceed the clear span plus the depth of the beam or slab. In continuous or restrained beams or slabs the span length shall be the clear distance between faces of supports, with the further provision that a certain allowance will be made for brackets.

The permissible width of flange in a T-beam is increased to 8 times the depth of the slab on either side of the web, whereas in the old Joint Committee report the limits was 6 times the depth of the slab. In other respects the two reports are in agreement on T-beams.

In the old report of 1916, the quantity of longitudinal reinforcement in spirally reinforced concrete columns was limited to a minimum of 1 per cent, and a maximum of 4 per cent, while the quantity of spiral steel was limited to not less than 1 per cent. In the new report the longitudinal steel in spirally reinforced columns is limited to a minimum of 1 per cent and a maximum of 6 per cent, while the spiral reinforcement shall be not less than one-fourth of the volume of the longitudinal steel. These changes encourage the use of hooped columns having both longitudinal steel and closely spaced spiral reinforcement.

In the design of reinforced concrete columns as well as in composite columns of reinforced concrete and structural steel or cast-iron, consideration is given to the ratio between the unsupported length and the radius of gyration, instead of the least side or diameter, as in the old 1916 report. Provision is made for reduced unit stresses in slender columns, where the ratio of length to least radius of gyration exceeds 40. This is a new departure, inasmuch as the old Joint Committee report and many building codes place an arbitrary limit on the length of a column at 15 times the least side or diameter. Other codes place the limit at 10. There is no reason why a reinforced concrete column or strut cannot be more slender than indicated by either of these limitations, provided the unit stresses are reduced proportionately. The new Joint Committee report supplies a formula for computing this reduced stress. This might be of considerable importance in the design of a reinforced concrete trestle, water tower support or some other structure of a similar nature.

How may the new Joint Committee report be utilized in that part of a building code relating to the design and construction of reinforced concrete structures? This question can be answered in several ways. The first and most tedious plan is to revise or rewrite the present regulations governing plain and reinforced

concrete so as to make them conform in all important respects to the recommendations in the report. The second plan is to wait for the completion of the report of the American Concrete Institute Committee now engaged in writing building code regulations on the basis of the new Joint Committee report, and then to incorporate that report in the general building code or printing it as a special ordinance. The third and simplest plan is to adopt the recommendations of the new Joint Committee report by reference only. This plan involves the elimination of all existing parts of the code that pertain to reinforced concrete design and construction, and the inclusion, in their place, of a paragraph such as the following:

"Features of the design and construction of reinforced concrete structures not covered by this section shall be governed by the rules and principles of standard practice, as published in the report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, dated August 14, 1924."

A footnote might state that copies of the Joint Committee report can be obtained from the secretary of the Joint Committee, 1315 Spruce street, Philadelphia.

The actual wording of this proposed paragraph is chosen in view of the probability that it might be desirable to print a few fundamental requirements, such as a table of unit stresses. Other matters such as the minimum thickness for reinforced concrete walls, enclosures, and partitions, for which no provision is made in the Joint Committee report, would have to be provided for. However, such special requirements could be placed in sections dealing specifically with thickness of walls and partitions.

In view of the very general acceptance of the Joint Committee as an authority, and the fact that this acceptance dates as far back as 1908, much trouble and expense could be saved in the preparation and printing of a building code if the third method of procedure were followed; that is, if the new Joint Committee report or its American Concrete Institute counterpart were adopted by reference only.

The foregoing paper by Mr. Stineman was presented before the eleventh annual meeting of the Building Officials' Conference at Madison, Wis., April 21-24, 1925.

STORM WATER INLETS AND CONNECTIONS

By John Wilson, City Engineer, Duluth, Minn.

The problem of storm water inlets is very nicely summed up in the opening paragraph of an excellent monograph prepared by Robert E. Moore, M. A., vice-president and treasurer of the Flockhart Foundry Company of Newark, N. J.:

"The development in recent years of hard surfaced, permanent pavements together with the discharging of large volumes of rain water into highways from the roofs of buildings and from sidewalks has made necessary the development of extensive storm water sewerage systems. The problems of adequate disposal of storm water, once it has been brought beneath the surface of the highway have been adequately solved. There has, however, been no systematic comparative study made of the various types of devices used throughout the country to remove the water from the gutter of the highway to a point beneath the surface. The widest divergency and lack of standardization of practice prevails in this regard. Hardly two governmental engineering bodies in the country have identical standards. Each engineer has sought, because of the lack of available material pertaining to this subject, to work out his own particular problems. As in any other undertaking, lack of systematic cooperation has not produced the results which an opposite course would. Incidentally it may be remarked that exactly the same situation prevails in regard to manhole frame and cover design."

The amount of water reaching storm water inlets will of course vary widely according to local conditions, size of block, width and grade of streets, the nature of pavements, the amount to which the block is built up, and whether it is the custom to connect rain water leads direct to the sewer or allow roof water to reach the gutters and thence the inlets.

For an average block of 300 by 400 and roof water reaching the gutters, a fair maximum discharge would be 4 cu. ft. per second assuming a rainfall of 1½ ins. per hour. The usual arrangement of inlets would provide about four to each block, necessitating an average capacity of 1 cu. ft. per second per inlet.

Very rarely can the inlets be so arranged that an equal distribution of water is secured—in fact, it is quite pos-

sible a single inlet will be called upon to dispose of at least half the total or 2 cu. ft. per second.

When storm water sewers were first being constructed streets were not paved to the extent they are now, and probably were cleaned but twice a year, just after the snow had gone and again preceding the fall freeze up. Power flushers were unknown.

Today the paved street is the rule rather than the exception, and power flushing is generally the accepted method of street cleaning. We are no longer sprinkling the dust several times a day to keep it on the street, but are washing it off at least every other day.

Twenty years ago only the driver of a blind horse or mule worried much about storm water inlets. But the modern driver rebels against dodging gaping holes near the curb or being jolted over depressions and cast-iron grates in the gutter.

Then, too, there is a little use for the old-style catch basin which was seldom cleaned except when the new officer went into office with good intentions but no knowledge of his limited funds.

Now, as a matter of good practice, nothing should be allowed to enter an inlet that cannot be carried through the sewer to the outlet. Most wastes of an objectionable nature that enter the sewer by way of the inlet are introduced while flushing the streets.

The average power flusher discharges at a rate little in excess of one-half a cu. ft. per second, and the average rate that this flows into the inlet is not much more than half that or about one-sixteenth of the desired capacity of an average inlet.

The inlet most commonly used and which seems to be a general favorite is the combined gutter and curb opening.

The amount of clear opening varies widely with the different makes, but in general is something over 1 sq. ft. in both grating and curb.

As a matter of experience little of the grate openings can be depended upon, as they are so easily clogged with grass, etc. Therefore, reliance must largely be placed on the curb opening.

Water in entering the curb flows at right angles to the direction of the velocity of approach and may roughly be considered as flowing over a weir without velocity of approach and with end contraction.

Some Figures

Thus assuming the water entering through the curb opening only and not exceeding 2 ins. in depth, as this is about as much as the grating can be dropped below the gutter line, the opening must be about 5 ft. long to admit 2 cu. ft. per second.

It is not an uncommon thing to find inlets provided with 12, 15 or even 18 in. outlets when it is impossible to get more water into them than a 6 or 8-in. pipe would carry away.

Suppose we wish to keep the velocity of street flushings passing the connection up to 3 ft. per second. This will require a velocity of 6 ft. in a pipe running full at 2 cu. ft. per second. or an 8-in. pipe at a grade of about 3½ per cent. However, considering these connections as short tubes with both entrances and outlet disturbances, we will find that a 10-in. pipe with a grade of 4 or 5 per cent will leave little to be desired. Anything large enough to obstruct a 10-in. pipe is too large to enter a sewer.

As an example of what may enter an inlet, last summer I found a 10-gal. lard can and a boy's sleigh that had entered one of our old-time designs.

Large connections are not only an unnecessary expense but they permit frost to enter the sewer further than the smaller ones and are also more easily broken. The steep grade on the connection pipe, in addition to being self-cleaning. tends to prevent reverse currents of air, consequently reducing the trouble from freezing.

With vitrified pipe laid as close to the surface, as most of our storm water connections must be, there is danger of the pipe being broken by the pinching action of the frost. Consequently it is good policy to reinforce such pipe with concrete.

Reinforced concrete pipe, well made, is preferable to vitrified pipe when laid above the frost line.

While not wishing to advertise, to my mind one of the best inlets yet devised, and one where good theory and practice conform very closely, is that of the Flockhart Foundry Company, 25128, of which I have taken the liberty of making the drawings.

This inlet is about 2 ins. too high for a regular 6-in. curb, but an adjustment along that line would be a simple matter.

The angle between the curb piece and gutter frame should be at least as sharp as that between the curb and gutter. Both pieces should be rigid and strong.

The grating should be well reinforced and machined to a true surface to fit a machined seat or recess in the frame. The fit thus secured will prevent a great deal of breakage and make the grates interchangeable.

General Rules on Inlets and Connections

The following are a few general rules as to inlets and connections that might profitably be kept in mind:

Construct the inlet so that it will be self-cleaning.

Lay the pipe straight from inlet to manhole without elbows of any kind.

The invert of the pipe at the connection with the manhole should not be below the center line of the sewer.

Modify all rules in accordance with local conditions and the rule of reason, the latter to be duly tempered with the laws of hydraulics.

In Duluth an effort is being made to secure a continuous concrete curb over the curb opening, a practice which is very questionable. The grate openings are about 2¼ sq. ft. in area and the curb opening about one-third of a foot. As might be expected our inlets are not entirely satisfactory, but we hope to improve on them in the near future.

There is one interesting inlet I would mention before closing, that used in St. Louis. This inlet has the curb opening only, which amounts to about 5¼ sq. ft., and is in all 13½ ft. long.

While this inlet may suit conditions in St. Louis, it is possibly much more elaborate than most of us require.

There is unfortunately a tendency on the part of some manufacturers of proprietary catch basins to feed the public up on a lot of nonsense about the menace to public health by sewer gas escaping through the inlets.

All that glitters is not gold. Neither is all that smells a menace to public health.

Fortunately, however, most objectionable odors can be eliminated by simply building along sane lines, rather than in accordance with patented equipment, although there are a number of meritorious patents.

The fact of the matter is that if streets are kept clean and nothing allowed to accumulate either in the inlet or the connection, we may expect little trouble from sewer gas, except in some cases with combined sewers.

The foregoing paper by Mr. Wilson was read at the 1925 meeting of the Minnesota Surveyors and Engineers Society.

BITUMINOUS TREATMENT OF GRAVEL ROADS

By A. D. Carpenter, Tarvia Department, The Barrett Co., No. 1, 19th Ave., South, Minneapolis, Minn.

The need of a low cost road is of interest to people of all classes throughout the country, and at a recent meeting of the Highway Research Board of the National Research Council, a great deal of time was given to the consideration of this question. Naturally the building of any type of road requires the handling of a great bulk of heavy material, and it just as naturally follows that in order to build a low cost road, the material must be close at hand. Fortunately in the great Middle West where such a vast mileage must be constructed and maintained, a good quality of gravel is quite widely distributed and bituminous materials easily obtainable.

The secondary roads of our country comprise by far a greater mileage than the primary roads or trunk lines, and the side streets in our cities and towns present a tremendously larger yardage than the through streets. But, it naturally follows that the secondary road, or the side street, is just as important to the man living upon it, as the trunk line or main through street is to the man living upon it. These streets and roads are also becoming increasingly important to the general public. How many times have we all chosen the more secluded highways or streets when out driving for pleasure, rather than follow the better paved thoroughfares with their congested traffic? This together with other causes is throwing an increased burden yearly upon the secondary street and highway with the result that many gravel streets which were successfully maintained by dragging two or three years ago, are now impossible to keep in good condition by this method.

To pave all these streets rapidly enough to meet the demand of the traveling public would be an impossibility from a physical standpoint provided funds were available for the purpose. As a result much experimentation has de-

veloped in the last few years looking toward a solution of the problem, and it seems likely now, that the same materials which proved of such inestimable value in saving the macadam roads of the country are to fulfill the same office with respect to our gravel roads. In fact there are many engineers of high standing in road building circles who have gone on record as saying that bituminous materials have already demonstrated that therein lies the solution of the gravel road problem and thus present the answer to the demand for a roadway of low cost that can be quickly constructed.

The American Association of State Highway Officials recommends that its Maintenance Committee at the very outset of its 1125 work give attention to this important subject as follows:

"Subject No. 1—Study methods and costs of maintaining gravel surfaces with bituminous surface treatments."

"The necessity for protecting gravel surfaces by surface treatment where traffic averages 400 vehicles per day or more is very evident for the following reason:"

"First: Conserving material."

"Second: Safety and comfort."

"Third: Economy."

Conserving Material

"Few localities have local gravel deposits sufficient to construct the roads that will be demanded in the community."

"Where traffic reaches an average of 400 vehicles or more daily, the loss of material annually is not less than 300 cu. yds. per mile, which under average conditions will cost $750 to replace. If consumed for replacement purposes on the main roads, little if any gravel will be available in the future for secondary roads, the demand for which is sure to come."

Bituminous Treatments

"The committee recommends the use of light bitumens for surface treatment of gravel surfaces."

At the 1925 meeting of the American Road Builders' Association, held at Chicago, I had the pleasure of listening to a very able paper presented by Mr. Hinkel, the maintenance engineer for the State of Indiana. I quote from his paper as follows:

"The method of maintaining gravel roads smooth and dustless by the application of a light grade of tar (15 to 30 viscosity) has been demonstrated to such a degree by the State Highway Departments of Maine, Wisconsin, Michigan and Ohio, that it is proved it is beyond the experimental stage. Maine has been doing this class of work perhaps longer than any other state and all of the states which are doing this work are convinced that they are following the proper course under certain conditions of finances."

Data on Bituminous Treated Gravel

I have tried to get a census of the mileage of bituminous treated gravel in sections of the country where it is most common, and find it difficult to get much of an idea of the amount treated annually by cities. State highway departments, however, are able to give reliable data, so that with all material at hand the following is believed to be approximately correct. New England treated in 1924 about 2,850 miles in states, cities and towns as follows:

New Hampshire	1,000	miles
Maine	700	"
Vermont	225	"
Rhode Island	100	"
Massachusetts	825	"
Total	2,850	miles

The following State Highway Departments in the Middle West treated about as follows:

Wisconsin	200	miles
Ohio	75	"
Michigan	100	"
Minnesota	50	"
Total	425	miles

The Maine highway work referred to dates back in its initial stages to 1912. Their problem there has been to take care of a tremendously heavy summer traffic along the Eastern coast. Six thousand or seven thousand automobiles per day is not unusual over some of the bituminously treated gravel roads for a period of three or four months in summer. Under such conditions it is only natural that the best methods would earnestly be sought.

But, it is not to hte State Highway Departments alone that we may turn for actual knowledge gained through experience in this matter. Many of the smaller cities and towns well scattered over the United States, but particularly in the eastern part, have found that through gravel near at hand and bituminous materials quickly available, a near pavement can be quickly secured and maintained at a cost less than the interest

upon an investment necessary to construct a pavement suitable to meet their needs. But, lest these general statements of such an optimistic nature lead us to expect too much and become overenthusiastic we beg to lift up a warning voice! Some gravels do not lend themselves readily to successful treatment, and when a treatment is once applied to any gravel road, the engineer should realize that he is entering upon a policy of maintenance, and that his road will probably be worse than ever if he does not continue to maintain it year after year in this manner.

The nature of the gravel and the condition of the roadway, therefore, should be very carefully considered and every effort made to make these conditions as ideal as possible before the first treatment is applied.

Characteristics of Good Gravel

The gravel, that, from its nature is the one most likely to give good results should contain a large proportion of metal which may range in size from one-quarter inch to an inch or more in diameter, with, of course, just enough fine binding material to permit of a good cross section being retained under traffic until the roadway is completely consolidated for the treatment. Gravels passing the following screen tests have been successfully treated:

	Per cent
Passing a 1½" screen	100.00
Passing a 1½" and retained on a ¾" screen	11.7
Passing a ¾" and retanied on a ½" screen	6.7
Passing a ½" and retained on a ¼" screen	16.9
Passing a ¼" and retained on a ⅛" screen	17.3
Passing a ⅛" and retained on a No. 50 screen	29.4
Passing a No. 50 screen	4.7
Clay content	13.3

Recommended Procedure

As some time is required for consolidation to take place it is not usually advisable to treat a gravel road the same year it is constructed. The most satisfactory results are usually obtained by making preparation one year for a treatment to follow the succeeding year. That is, if the roadway does not contain a sufficient amount of gravel to last through the spring thaws without seriously breaking up, more gravel should be added and narrow places widened out, proper ditches constructed and all precautions taken to enable the obtaining of a proper cross-section by means of dragging the following spring.

This dragging should be done as early as possible and while the roadway still is moist enough to permit of a quick hardening up of the surface as soon as the spring sun and the traffic is sufficient to bring about this desired result. In some cases where the roadway is potted out to a considerable extent, it may be necessary to precede the grading by scarifying. This should be done to the depth of the deepest holes, but care should be taken not to go deeper, as the old surface properly bound in has reached a better degree of consolidation than it will be possible to get after it is disturbed and before treatment will be necessary. Any blade grader suitable for shaping of gravel roads may be then used for grading into a good cross-section, which should be treated with the bituminous material just as soon as the hardening above mentioned has obtained. This will probably be in the course of a month in this locality, but in some instances it may be necessary to treat earlier because of the heavy traffic.

Before treating the surface, it should be swept clean of dust or very fine material of any sort, thus permitting the application of the bituminous material to a clean surface. There are some exceptions, however, to this rule, as a gravel not containing quite enough binding material to properly consolidate it, may be treated if it does not contain too large a percentage of very fine gravel. It always requires more bituminous material, however, to properly bind loose gravel than one that is already consolidated. The best results in either case are obtained by gravels which permit a penetration of the bituminous material to the depth of one-half to one and one-half inches, thus forming a well-bonded crust of the top layer of the roadway itself rather than the building up of a mat over the surface.

Amount of Bituminous Material

The amount of bituminous material necessary will vary somewhat depending upon the nature of the gravel to be treated, but generally for the first treatment about ½-gal. per sq. yd. will be necessary. This is usually applied in two applications, letting the first one of about ¼-gal. thoroughly soak into the roadway before the second is applied. In the case

of tars, this first application is not covered with sand or gravel as it will set up in two or three days at the most, and sometimes in the course of a few hours. With certain grades of oils it will be necessary to cover this first application with sand or gravel, when traffic may be allowed upon it for some time before the second application is made. If tar is being used it is generally better to follow within a day or two with the second application, which should be covered preferably with a coarse gravel free from clay or dirt of any nature.

Cover Material

The amount of cover material necessary will range rather widely, depending upon the gravel treated and the kind of bituminous material used, but a minimum of about 40 cu. yds. per mile, or 1 cu. yd. to 260 sq. yds. will be needed. Sometimes it may be necessary to use nearly twice this amount. Where possible, this cover material should be placed along the roadway after it has been cleaned and before the bituminous material is applied. It is usually best to place it in piles of about ¼ cu. yd. each, and 20 to 25 ft. apart. These should be placed on the shoulder, in the gutter, or perhaps on the sidewalk, so as to be entirely outside of the zone to be treated. This cover material is then quickly spread by shovels with one man working at a pile, or at the most, two men, who should be matched up so as to have a right-handed spreader and a left-handed spreader working at the same pile. Too many men grouped around the same pile not only delay the work, but produce a very uneven job of spreading.

Where a considerable yardage of this work is to be done, mechanical sand spreaders are now available which are doing satisfactory work. The most satisfactory one is so designed as to be attached to the rear end of a truck and is kept constantly filled by elevating the body, thus permitting the gravel to run down into the spreader at the top as it is thrown out at the bottom. The truck is then run backwards over the freshly sprayed bituminous material, the layer of gravel thus spread preventing the material from picking up on the wheels of the truck.

In the case of hand spreading where the initial piles prove to be insufficient, it is always possible to drive directly over the material after it has received the amount thus spread from the piles in question.

Signs During Treatment

Where it is impossible to close up a road during treatment, one side only should be treated at a time, leaving the opposite side open to traffic. Rest assured, however, that traffic will not keep to one side entirely, even with signs at either end of the treated section calling attention to the fact that it is sprayed with fresh tar or oil. These signs should never be omitted as it is not only fair to the public to safeguard it in every way possible, but in the case of accidents due to skidding, these signs give the engineer in charge a very much better legal status than he otherwise would have. In fact it is generally the case that the signs absolve him absolutely from any responsibility if an automobilist drives into the freshly sprayed material with any damaging results. Don't forget the signs.

Proper Maintenance

After the roadway has been properly treated in this manner, and the traffic has had a little chance to iron it out, it will present the appearance of a pavement, but be not deceived, it is not a pavement, and unless properly maintained it would be much better in most cases had it never been done. Every day or two for a few days after treatment, the engineer should see that the road is inspected, that wet spots are covered with a new supply of gravel just sufficient to blot them up, and that any weak places which may have broken out are patched up with more of the bituminous material. This may consist of simply brooming a little over the surface of places that were perhaps not properly cleaned and thus allowed the material to peal off, or it may be by patching holes of some little depth which have appeared because of too loose a condition. This patching should be done with a mixture of gravel and the same bituminous material with which the road was treated, or with perhaps, a heavier bituminous material cut back with a volatile solvent.

It frequently happens that with careful patching of any such defective places which may be evident within the first month, the roadway will go through the balance of the season with comparatively little attention. This should not be assumed to be always the case, however, and frequent inspection of the roadway should be made, as in this case it does

seem as though "a stitch in time," saves not "nine," but ninety and nine. Any holes or breaks, therefore, that occur at any time should be located and repaired at once. Only a small amount of equipment is necessary for this purpose, as in gravel treatments the bituminous materials are nearly always used cold. Brooms, shovels, and a pouring pot or two are about all that is necessary. Such appliances are generally in the possession of all up-to-date street departments, so that it may be said that no new appliances are necessary. On the other hand if a large yardage is to be maintained in this manner, and it is believed by many that this will be the case in most cities within the next five years, then it may pay to equip a little more extensively for this purpose.

Until a much larger yardage obtains, however, than is now existent in the average Minnesota city, this maintenance work can be very satisfactorily handled by keeping a pile of the bituminous material and gravel properly mixed and ready to load into a truck which should make the circuit of the treated streets as frequently as necessary. The holes can be properly cleaned with brooms and shovels, and the mixture placed in them to be rolled out and cemented under the action of the traffic. The proportions for making this mixture vary widely—in some instances as low as 12 gals. of bituminous materials to a cu. yd. of gravel being sufficient, while other material require as high as 27 gals. per cu. yd. It is always well, in preparing a mixture, to have the directions issued by the manufacturer close at hand.

When entering upon a policy of this sort it is only natural that the engineer should ask questions in regard to the cost and the amount of traffic a treated roadway can be expected to bear.

With a combination of good gravel and proper treatment it is not unusual for roads of this nature to successfully carry several thousand automobiles per day. The cost of treatment will vary between $500 to $800 per mile for the initial treatment, and as low as $200 or $300 on succeeding treatments until such time as the roadway will need to be scarified and reshaped, when the total cost for one year may be in the neighborhood of $1,000. The above figures are based on an 18-ft. roadway, which reduced to yardage would vary, roughly, between 2 cts. and 10 cts.

One Minnesota city which has been doing this work consistently for 8 years reports an annual cost per year of something under 3 cts. per yd. Another city where a smaller yardage is being treated, reports that the cost for the last four years has been less than the cost of sprinkling adjacent streets with water to keep down the dust. In this particular case, one section of a treated street was used as a temporary trunk line for one of the most important state roads during the past summer, and it carried the traffic in an entirely satisfactory manner, requiring but little maintenance work during the time. Another municipality reports one project where 60,000 sq. yds. were treated at a cost of $0.0735 per sq. yd., another project consisting of 39,000 sq. yds. cost $0.045 per sq. yd., while a third one consisting of about 60,000 sq. yds. showed a cost of $0.0537 per sq. yd. These latter were all streets that had been treated successfully for a few years and some scarifying and reshaping was necessary. All these streets carried several thousand automobiles per day, and were maintained in a satisfactory condition.

Different State Highway Departments report costs more uniform, but on the average higher. One state reports a 3-mile stretch of 24 ft. roadway costing $1,175 per mile for the initial treatment; another stretch of 1½ miles costing $975; a third one $1,192, and two others $891 and $946 respectively per mile. Others report costs as low as $500 per mile. while still others give a general average of $700 to $800, with occasional years exceeding $1,000 for an 18-ft. roadway.

The foregoing paper by Mr. Carpenter was presented before the 1925 meeting of the Minnesota Surveyors and Engineers Society.

CARE OF CONCRETE LINED RESERVOIRS

By R. E. McDonnell, of Burns & McDonnell Engineering Co., Consulting Engineers, Interstate Bldg., Kansas City, Mo.

Reserve storage reservoirs are usually located at high points, remote from the towns and often at inaccessible spots, all of which tends to prevent their observance and inspection. Because of their elevation above the city, there is added, in case of accident, the danger and menace to lives and property which is all the more reason for their frequent inspection and repair.

A reserve storage capacity of about three times the average daily water consumption is advisable regardless of whether the supply is from wells, streams, lakes or whether the water is pumped or from a gravity source. To store this volume of water above the city is a safety precaution needed to tide over breaks in flow lines, break-downs in pumping equipment, storm swept transmission lines, power house fires, fuel delivery interruptions, floods, and the many other accidents that are constantly occurring. A sprinkler system installed in mercantile buildings and factories is well recognized as a valuable added precaution and yet its chief value to the owner would be lost if it were not for the frequent inspections.

Lives and protection of property are so dependent upon the reserve water supply that it is surprising how little care and inspection are given to reservoirs, with the result that breakages are constantly occurring.

It is almost impossible to construct a large earthen reservoir lined with concrete and not have leakage. Earthen banks will settle and tests made show settlements will occur fully two years after completion, even if the embankment is carefully deposited in layers, wet down and rolled. The best and surest way to avoid leakage is:

(1) A careful study and test of the soil and material used in the construction.

(2) Design and plans utilizing the best recognized engineering skill and experience with ample factor of safety.

(3) Inspection of the most rigid character.

After complying with all three of these requirements and getting a structure as near perfect as possible, it still remains a fact that many reservoirs will leak, and small leaks neglected soon prove serious.

Many methods of waterproofing have been used with more or less success. Double layers of concrete slabs with waterproofing membrane between slabs is proving quite satisfactory with the top slab serving as a protection to the membrane. Gunite has proven especially satisfactory to repair old reservoir linings and now its application upon a wire mesh in newly constructed reservoirs seems to be satisfactory construction.

Inlet, outlet, and overflow pipes are often the source of leaks and a test of these under the same pressures of operation before they are covered would save many an engineer and contractor much trouble.

An inspection of six reservoirs in as many different states all of different designs, was made by the writer and the care, inspection, tests, and observance of the reservoirs or lack of it, were interesting.

One was inspected almost daily for settlement, leaks and cracks, and not until 18 months after beginning use did all settlement cease. Some expansion joints had opened, the curb had lost its perfect alignment and after emptying and making the repairs no further leakage or cracks have appeared for the next 6 months.

One reservoir visited was in such constant use for 12 years that it could not be emptied, and showed considerable increasing leakage, many joints separated, some slipping down of concrete side slabs and a condition indicating a rather high loss of water. At this place a new reservoir is now being rushed to completion and a complete overhauling of the old reservoir will then be possible.

One of the reservoirs inspected had been in use a year. All pipes in and out were tightly closed, evaporation was carefully estimated and after 36 hours' standing, no loss of water could be observed.

One reservoir of about 15,000,000 gallons capacity showed, upon being filled, a seepage both through expansion joints and the concrete slabs that was considered too high for safety and after a few months' use it was given an interior coat of gunite, and now whenever any cracks appear the water is lowered and repairs made, the repair materials being kept constantly available. This reservoir now shows from meter readings and a pipe drainage system, that all leakage has ceased after two years' use.

One reservoir where a break out of the water did occur (costing about $1,500 for repairs) shows, that for the four months after it had been placed in service, there was a lack of observation, no inspection of possible leakage, and no attention paid to a drop in the recording water level gauge in the pump station, several hours previous to the break. The lack of attention might have been caused by a factional political fight or through a feeling of false security because the contractor had given a bond for the maintenance of the reservoir. The bond

didn"t prevent the break, loss of water and damage to other property but the contractor did, at his expense, make the repairs.

While writing this article on a train, I've stopped long enough to read the evening paper and on the front page are accounts of two reservoirs, one collapsing, causing, as the paper states, "No loss of lives but a washing away of small houses, barns, wooden implements and furniture and covering of lawns and streets with mud and debris of all kinds," etc. The other reservoir is mentioned under "Council Proceedings" and states, "The new reservoir on the hill, completed last year, was ordered repaired by the City Engineer who estimates about $8000 for labor and materials will be required to place the reservoir in condition for use."

These matters are not pleasant from the standpoint of the designing engineer, the supervising engineer, the contractor, the city administration, or the public who pay the bills; but when engineers and contractors exercise their best skill and judgment in trying to get a perfect structure, it should by no means be forgotten by the owner, whether private or municipal, that these structures should have constant observation, daily inspection for at least during any period of settlement. They should also be inspected frequently from the standpoint of sanitation as well as safety.

One unfenced concrete reservoir with sloping sides was visited recently by the writer, accompanied by the superintendent of the water department and to our surprise we found a cow floating in the water. The cow in trying to get a drink had evidently slipped in. How long the cow had been drowned no one knew; the superintendent knew the cow was not there on his last visit about two weeks previously.

I have often visited reservoirs with city officials and apparently they were astonished at the algae growth over the water and assured me that it was all new to them but to an experienced waterworks man it showed weeks of neglect.

Everyone realizes the necessity of inspection of pumps, filters, machinery and equipment, but after spending over 25 years designing and supervising water works installations, I'm convinced that reservoirs are the most neglected, yet one of the most vital features of a good water works system.

HIGHWAY FINANCE REPORT OF NATIONAL TAX ASSOCIATION

(Concluded from April Issue)

Your committee is not prepared to recommend any fixed percentage of total highway expenditures as the proper percentage to be financed by special taxation of motor vehicles. The different stages of highway development reached by different states, the differences in the relative burden of highway finance in different regions because of differences in the density of population, in per capita mileage of roads, in climatic conditions, in availability of highway building materials, in per capita ownership of automobiles, make different distributions of the burden politically inevitable and probably also theoretically equitable, and no one formula will best suit the needs of all the states. But for all states except those at the very inception of their program of improved highway construction, special taxes on highway users should be sufficient to defray a substantial part of the costs of construction and of interest on highway indebtedness, as well as all of the maintenance costs of primary highways. The tendency in highway finance is strongly in the direction of placing on highway users an increasing proportion of the burden of highway finance. We approve of this tendency, not only as an inevitable result of the pressure of facts, but as thoroughly consistent with equity and with expediency.

Financing Local Roads

Roads of a purely local interest, serving only local needs, should be financed out of local revenues obtained either from local or general tax revenues or from special assessments on adjoining land. When such local roads, however, are improved and absorbed into the state highway system and lose their purely local character, they should be financed out of state funds derived mainly from motor vehicle taxes. Special assessments ordinarily have no place in the financing of primary roads. They should be used in connection with the financing of local roads only to meet part of the construction cost, and the amount of the assessment should never be greater than the increase in the market value of the adjoining land which would unmistakably and immediately result from the improvement. We do not regard as within the scope of our task a consideration of the problem of the financing of city streets.

Returns to the Benefit Principle

Special motor vehicle taxes for highway purposes represent a return to the principle that those who derive direct benefit from government services should contribute to the cost of such services in proportion to their benefit therefrom. Some modern writers on public finance have largely thrown this principle overboard, and find little or no proper scope for its application beyond its limited use in the levy of fees and special assessments. The trend of taxation practice for other than highway activities has during the last few generations also been decidedly away from the benefit principle and toward the principle that government services should be made freely available to all and should be financed by taxation according to ability. The field of highway finance presents almost the only instance—if not actually the only one—in modern American financial history of the sharp reversal of the trend from benefit taxes to ability taxes. Is this reversal of the trend justified? If so, has it gone too far or should it go still farther?

The abandonment ot the benefit principle was due in the main to the influence of the modern concept of the social solidarity of the people, which appeared to justify the policy of requiring the more prosperous classes to pay the cost of services which the poorer classes would in large part enjoy. Under the influence of popular pressure, governments extended their functions so as to include new types of activities expensive to finance and many of them distinctly serving the masses of the people rather than the wealthier classes. The poor could not afford to meet the cost of these new activities without making serious sacrifices. The main objects and results of the shift from the benefit to the ability principle were, therefore, (1) to enable the government to provide for the masses services whose costs the latter could not or would not directly defray, and (2) to shift the burden of financially supporting the more general activities of government from the population as a whole to the relatively wealthy classes.

To the extent that the great rise in highway expenditures has been incurred on behalf of the non-industrial automobile use of roads, the ordinary argument for the application of the ability principle fails altogether to apply. There is not any problem here of making a government service freely available to the poorer classes who otherwise could not afford to avail themselves thereof. The really powerful arguments against the benefit principle of taxation, namely, that it shifts burdens to those who are not able to bear them and that it therefore makes impossible the financing of such government activities as are predominantly for the direct benefit of the masses, have, therefore, a narrowly limited applicability to this phase of the modern problem of the financing of automobile highways.

In the case of commercial and industrial automobile use of highways, the situation is not essentially different. The benefits of the improved primary highways accrue immediately to the automobile owners in the form of lower transportation costs and will in general be passed on to consumers in the form of lower prices or else will be absorbed as extra profits by the producers or the owners of productive property. To the extent that the general public shares in the benefits of cheaper transportation, special taxation of highway users will be passed on to them. In the last analysis owners of industrial automobiles will shift any special automobile taxes imposed on them to those who derive the economic benefit from the highway improvements.

There can be no reasonable ground for doubt that the direct benefits from highway improvements go in the first instance to the automobile owners or to those who are directly served by automobile transportation. These are not, of course, the sole beneficiaries of the highways, but they are by far the chief ones. That there are secondary benefits from the use of highways which accrue to others than those immediately served by highway transportation is not a valid objection to the financing of highways on the benefit principle. No one would contend, because there are secondary benefits from the existence of a suitable water supply which accrue to others than those who actually make use of the water service, that it is unfair to finance a municipal water works by special charges on those who are directly served by it. If any municipality ever departs from the benefit principle in financing its water works, it is not because of the existence of indirect and secondary benefits to the general community from the water system, important as these are, but to relieve the poorer classes of the necessity of meeting the cost of the direct benefits accruing to them. Where electric or steam railroads are operated by the state, it has not been generally re-

garded as inequitable to the direct users of these public works that the special charges to users should be sufficient to finance the enterprises. But there are indirect and secondary benefits accruing to others than the direct users in the case of railroad transportation as much as in the case of highway transportation.

Were the issue in the case of highway finance really between the ability principle and the benefit principle, it would not much matter, in so far as the equitable distribution of the burden of highway costs was concerned, which method was chosen, since either method would in the ultimate analysis probably result in about the same distribution of taxes. But the real alternative in state and local finance in the United States is between the benefit principle and the general property tax. It has been repeatedly disclosed by careful investigators that the general property tax works out in practice at a higher rate on small parcels of property than on large. A large fraction of the property tax on improved real estate and on personal property, moreover, is unquestionably shifted by the first taxpayer to the masses of the population in the form of higher rents and higher prices for commodities and services. It is altogether probable that with the existing distribution of ownership of automobiles the financing of primary highways by special taxes on highway users will conform more closely to the ability principle than will the resort to the general tax revenues of state and local governments for highway funds.

The argument from expediency also justifies the resort to automobile taxation as a means of financing highways. In most of the American commonwealths the existing revenue systems are already strained to the utmost to meet the calls for revenue from the expanding programs of government activity. The tax burdens on real estate and on the farmers in general are already as great as they can reasonably be expected to be able to bear. The great need in state and local finance is the discovery and adoption of means to lighten the tax load on the overburdened classes. To finance highway expenditures out of general revenues means in practice to finance them by additional taxes on tangible property, real and personal. Under existing conditions it is much more equitable to place the burden of highway finance on those who use the highways in proportion to their use, rather than on property owners irrespective of their use of the highways.

The payment by highway users of all maintenance costs of primary highways and of a substantial portion of construction costs and interest on indebtedness incurred in the construction of primary highways is well within the limits of their reasonable capacity. The motor vehicle registrations in 1923 in the United States totaled 15,092,000 and will undoubtedly pass the 17,000,000 mark in 1924. Although primary highways now comprise not more than 10 per cent of the total road mileage of the country, and probably will not exceed for a long time 20 per cent of the total mileage, they account for 85 to 90 per cent of the total highway costs. The average levy per automobile which would pay all maintenance and interest costs and would provide a generous fund for amortization of construction costs of primary roads would not greatly exceed the average special tax burden per automobile now imposed.

The annual registration of automobiles is increasing more rapidly than the annual highway expenditures, so that the average levy per automobile which would be necessary to finance all the highway costs, for secondary as well as primary roads, is progressively diminishing. If the expenditiures of automobilists on the upkeep of their cars, on gasoline and on garage hire be considered, it is not unreasonable to hold that an annual levy adequate fully to meet the program laid down in this report would not be beyond their ability to pay and would not exert an appreciable adverse influence on the rate of development of automobile transportation. While your committee does not recommend that the cost of purely local roads should be met by special motor-vehicle taxation, and while it does not regard it as immediately practicable that even all primary road costs should be financed by motor-vehicle taxes, it regards with approval what appears to be a tendency in this direction and welcomes progress toward that goal, especially for states and counties which have completed or are approaching the completion of the construction of their primary system of improved highways.

The Legitimacy of Highway Transportation

The resolution of the National Tax Association authorizing the appointment of this committee instructed it to consider

the question of "the co-ordination of the taxation of transportation agencies using the highways with other transportation agencies." Motor transportation, whether of passengers or of freight, and whether as a common carrier, for hire, or for personal use, is not wholly competitive with other modes of transportation, but is, to an important and growing extent, complementary to them; but even where it is essentially complementary the sound method of determining where one shall begin and the other shall end is through the free play of supply and demand after each type has met all the costs properly attributable to it. If any type is permitted to escape meeting any of the costs with which it can properly be charged, the result is an artificial stimulation of the favored type which leads to its expansion beyond its natural economic limits and is unfair to competing methods of transportation and to the general taxpayer. If the program of highway finance laid down in this report were executed, your committee is of the opinion that all justification would be removed for charges against motor transportation that it is being subsidized in its competition with other transportation agencies.

V. Apportionment of Highway Costs Between Federal, State and Local Governments

Our report has already urged the importance of centralized control over the planning, construction and maintenance of primary roads. But under the American type of political organization no great measure of centralization of financial control is feasible unless it is accompanied by the assumption on the part of the central authority of a substantial measure of responsibility for financing the activity in question. Except through centralized financing, moreover, it is impossible to apportion the costs of a co-ordinated highway system in even rough accordance with the territorial distribution of benefits from highways or with the territorial distribution of ability to pay.

Federal Aid

Federal aid to highways has been valuable under these circumstances. By its highway grants the Federal Government has secured the opportunity of giving advice, of laying down minimum engineering standards of construction and maintenance, of assuring the development of a nationally coordinated highway system, and also of lightening the burden for those states of sparse population and long distances which are crossed by important national automobile routes, but which could not reasonably be expected to meet the full cost thereof from state and local revenues. It is important that federal aid should never be given without conditions being attached which will assure their proper utilization, but the administration of federal highway aid by the Federal Bureau of Public Roads under the able direction of Mr. Thomas E. Macdonald has been of a highly satisfactory character and is entitled to the commendation of all who are interested in the full and scientific development of the American highway system.

The Federal Government has collected in special taxes on motor vehicles and parts to June 30, 1923, a total of $589,012,000, but during the same period has spent on highway aid to the states and on forest roads, including administrative expenses, a total of $264,782,000, or only 45 per cent of the receipts from motor vehicle taxes. Your committee recommends that the Federal Government should derive the revenues which it devotes to highways from the special taxation of highway users, Mr. Brosseau, however, dissenting. (Mr. Brosseau presents the reasons for his dissent in a statement appended at the end of the report. The other members of the committee are of the opinion that the general reasoning of this report in support of the principle that highway expenditures should be financed by special taxes on highway users applies with as much force to federal as to state highway expenditures.) These federal taxes should, if possible, take some form other than an ad valorem tax. To the extent that its aid is granted to projects constructed primarily to serve the purpose of national defense or to open backward regions to colonization, the Federal Government would be justified in using funds derived from general tax revenues. But the Federal Government should not levy taxes on motor vehicles as such in excess of what it spends on highways. (Your committee does not feel that a consideration of the equity of levying taxes on motor vehicles as consumption taxes is within the proper scope of its task.) The reduction in the taxes on motor vehicles and on motor vehicle parts effected by the Revenue Act of 1924 meets, therefore, with our approval. We recommend the total

elimination of the remaining federal excise taxes on motor vehicle parts.

Similar considerations to those discussed above in connection with the relation between federal and state highway finance apply with even greater force to the relation between the states and the political subdivisions. (With the exception, perhaps, of cities, whose street finance problems do not come within the range of this report.)

The counties, and even more so, the smaller political subdivisions, are no longer proper units of highway finance so far as the financing of primary roads is concerned. Dependence on local revenues for a substantial portion of the cost of primary highways means either gaps in the highway system because some localities are laggard in making financial provision for improved highways or the overburdening of some localities with excessive taxes or debts. Local financing of primary roads inevitably results in serious territorial inequalities in tax burdens, because of varying relations of mileage and local traffic to population and per capita wealth. Where the state develops main highways through the linking up at its own cost of local roads, localities which had been backward in improving their roads, escape their due share of the cost and localities which had shown more than the average degree of enterprise in constructing improved highways bear an undue share of the cost. In those instances where the finances of local governments have become seriously involved as a result of highway expenditures, it has usually been because they have assumed a disproportionate share of the burden of financing the primary highway system and have not received adequate aid from the state. The problem of highway finance, however, is becoming less serious for the local political units. The states are rapidly increasing the amount of highway aid which they grant to the localities. The construction and improvement of highways generally operate to raise the economic status of districts hitherto backward because of their lack of advanced means of transportation. Government studies have shown that the improvement of main roads tends to lessen the volume of traffic on local roads and thus reduces the maintenance burden falling on the local governments.

For purposes of highway finance, roads should be classified as local and primary highways, according to whether they serve purely local needs or the needs of wider areas. Local roads should alone be financed by the locality, whereas primary roads serving a wider area should be financed by the state. The principle here is sound in theory but is difficult of application. As the extension and improvement of the highway system progresses, it approaches ever more closely to being a unified whole, requiring control and financing on that basis. It is desirable, therefore, and it becomes more urgent with every expansion of the highway system, that highway costs be set as far as possible from state revenues derived from state taxes uniformly levied throughout the state. It is impossible to render exact justice as between the different localities, but the nearest approximation thereto can be made, especially as between, on the one hand, sparsely-settled or poor rural districts through which run expensive primary highways, and on the other hand, the urban centers which provide much of the traffic for these highways, if the state government assumes the entire burden of financing primary highways, leaving to the counties the financing out of local tax revenues of local roads not constructed or maintained in condition to be satisfactory for through motor traffic or used solely, or almost so, by traffic originating and terminating within the immediate locality.

Where the state provides all or part of the funds for financing the primary highway system, but the actual expenditures are made by the local governments, careful consideration should be given to the mode of apportionment of the state aid to the local governments. As in the case of federal aid, conditions should always be attached to the grants, to assure that the expenditures will be made in the manner best designed to carry out the state highway program. Apportionment of state funds to the localities according to a rigid and arbitrary formula, whether it be in proportion to population, road mileage, area, local highway expenditures, or equally to counties, all of which methods have been used, either singly or in combination with others, by one or more states, is bound to operate unsatisfactorily, for no one formula, no matter how carefully devised, can make adequate provision for the varying needs of different localities. A number of states fix the method by which apportionments shall be made by a special legislative act

for each apportionment. This is preferable to the fixed-rule method, but is open to the objection that it leads to political log-rolling and unscientific allocation of the funds. At least 12 states leave the apportionment of the funds to the state highway officials, subject to such broad limitations as the legislatures deemed essential. Your committee recommends this last method as the one best designed to secure a scientific and equitable apportionment of state funds.

VI. Motor Vehicle Taxes

All of the states levy registration taxes on motor vehicles and some three-quarters of the states levy gasoline taxes in addition. There is no uniformity between the states either as to the bases for determining the taxes or as to the rates of tax. The states base their registration taxes on value, cubic-inch displacement, weight, gross weight, or horsepower, or on a combination of two of these. One state levies a flat license fee uniform for all motor vehicles. One state levies a registration tax based on value, weight, horsepower, and previous number of registrations. Where horsepower or weight is used as the basis, some states levy a flat rate tax per unit of base; other states make the rate per unit rise progressively as the base rises; a few states make the rate per unit fall as the base rises. Some states levy heavier rates on automobiles with solid tires than on automobiles with pneumatic tires; other states do not. The gasoline tax rates vary from 1 cent per gallon to 4 cents per gallon. Some states tax all gasoline, whether used to propel motor vehicles on the highways or not; other states make varying exemptions for gasoline consumed otherwise than as motor vehicle fuel. Whether gasoline taxes are levied or not does not appear to influence the rates of the registration taxes levied on automobiles.

If only one motor vehicle tax were to be levied, the gasoline tax would appear to be preferable to the registration tax. The factors of most importance in estimating the costs accruing to the state from automobile traffic are the mileage traveled, the gross weight of the vehicle, and the speed at which it is driven, and the amount of fuel consumed reflects in some measure all of these factors. The gasoline tax is conveniently paid, easily collected, and easily administered. It is the only practicable mode of reaching highway users from other states than that levying the tax. Even where the tax is opposed at first by motorists it wins their approval or at least their toleration after it has been in effect for some time and they have grown accustomed to it. There is a marked tendency toward general adoption of the tax and toward a 2-cent or a 3-cent rather than a 1-cent rate. The yield of the tax has been moderate so far but with the increases in rates recently introduced and the adoption of the tax by more of the states, it has been estimated that it will yield $50,000,000 in 1924 as compared to approximately $30,000,000 in 1923 and $12,700,000 in 1922. A 3-cent tax on all the gasoline consumed in the United States by automobiles would net at least $150,000,000.

Registration taxes appear to be necessary, even where gasoline taxes are in effect, in connection with the regulation of motor vehicle ownership and operation. They also are useful because they can be devised to take more fully into account the influence of weight of car, weight of load and type of tire on highway wear and tear than does fuel consumption. A further factor in favor of the levy of registration taxes even when gasoline taxes are levied is that highways in general are constructed on a scale sufficient to accommodate the peak load of traffic and an automobile which is in the garage most of the year, and therefore consumes little gasoline, but is operated on the highways when traffic is at its peak, escapes its due share of taxes if it is taxed only on its gasoline consumption. A greater measure of uniformity between the states in the bases used for levying registration taxes is, however, highly desirable. Gross weight, by which is meant the weight of the vehicle, loaded with a standard load, is the best as it is the simplest base. Where weight or gross weight is used as the basis of taxation, your committee recommends that the rate of tax per unit of weight should be graded upwards as weight increases, the gradation of rates to be determined on the basis of engineers' tests of the comparative wear and tear on the roads and use of road space per ton of the different weight vehicles. Since the primary purpose of motor vehicle taxation now is to make the highway user meet in whole or in part the cost of the construction and maintenance of automobile highways, there is no justification for registration taxes which take into account the value of the ve-

hicle, such as ad valorem taxes, taxes which make allowance for the depreciation of the vehicle, or horsepower taxes intended to reflect the value of the vehicle. Even though there may be some relation between value of the vehicle and wear and tear on the roads, the latter can be better taken into account by other means than through taxation on the basis of value or some index of value. It is not reasonable to ask that the rates of tax, whether for gasoline taxes or for registration taxes, should be uniform as between the states, since the different financial requirements for highway purposes of the different states justify different rates of taxation. It is recommended, however, that each state, before fixing its rates of taxation should survey the financial requirements for highway construction, interest on highway indebtedness, and highway maintenance (including its grants in aid to counties and, after allowance for what is to be received as federal highway aid), should determine what proportion of its highway expenditures is to be set by motor vehicle taxation and should adjust the rates accordingly. It is also recommended that the counties levy no charges in connection with chauffeurs' or operators' licenses and that the states levy no such charges other than very moderate licenses fees not exceeding $1 each.

The levy of ad valorem rates on automobiles as personal property under the general property tax is not considered to be a special tax on motor vehicles or to have any direct relation with the problem of highway finance, and is therefore not regarded as falling within the scope of our report. Where motor vehicle registration taxes are levied in lieu of personal property taxes, only such parts of the registration tax revenues are to be regarded as special taxes on highway users as are in excess of the amounts which automobiles would pay under the personal property tax if they were not exempt therefrom.

There is no uniformity in usage as between the states in the disposal of revenues from special taxes on motor vehicles. In most of the states they are used solely or mainly for highway purposes, but in some states important fractions thereof are diverted to other highway purposes. Some states segregate their motor vehicle tax funds for construction purposes, others for the payment of interest on and the amortization of highway indebtedness, others for road maintenance expenses, and still others reserve them for highway purposes in general without further statutory specification. Many states distribute the proceeds of the motor vehicle taxes in part to the counties; other states reserve them wholly for their own use.

Your committee recommends that each state determine what proportion of its highway expenditures it proposes to finance from the proceeds of special taxes on motor vehicles and that it does not levy taxes on motor vehicles in excess of the rates necessary to produce such amounts of revenue, and it further recommends that in no instance shall the special taxes on motor vehicles exceed in amount the total highway expenditures of the state after deduction of the amounts received as federal highway aid but including the amounts distributed to the counties for highway purposes. Your committee cannot recommend, however, the rigid segregation by statute of the proceeds of motor vehicle taxes for use solely for highway purposes. Segregated treasury funds increase the interest expense of the government by cutting down the supply of available cash. It is important for the economical administration of state funds that special funds be eliminated entirely and that all receipts be placed in one general account. The proper balancing of highway expenditures and motor vehicle tax revenues should be provided for in the preparation of the state budgets rather than by rigid statutory requirements.

JACOB VINER, Chairman,
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A. J. BROSSEAU,
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C. C. CONVERSE,
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W. H. MALTBIE,
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W. C. QUERY,
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Statement by Mr. A. J. Brosseau

"Before stating the grounds for my dissent to a single item in the report of the Committee on Highway Finance, I desire to express my regret that I cannot give an unqualified endorsement to a statement which I believe in all of its other essential elements to be a fair and complete summary.

"The dissent to the recommendation that special federal taxes should be continued on motor vehicles to offset federal highway appropriations is *not* based on any objection to the motorist's participation in a substantial share of the costs of the highways which he uses. Instead, I have cordially supported that principle as laid down elsewhere in the report.

"The objection to the recommendation is based on the fundamental ground that there is no relation between federal appropriations for public improvements of general benefit and the discriminatory excise taxes which were levied against the motor vehicle after the Federal Aid act had passed and solely for the purpose of meeting emergency war revenue needs. It has never been the purpose of Congress to pick out a single industry to pay for improvements of benefit to all and there is no more ground for doing so in this case than in appropriations for rivers and harbors and other similar purposes. In fact, the whole attitude of Congress has been to repeal these taxes and I hope and believe that when and as revenue needs permit the automotive taxes will go as taxes on railroads, telephones, telegraphs and others have gone.

"Further, it is my belief that the field of special taxation of motor vehicles is one which should properly be left to the states. The government appropriates funds for primary highways on the constitutional grounds that they facilitate communication and promote the national defense. Federal aid amounts to but 14 per cent of the total highway program and has its greatest value not in its amount but in the standards which it sets up. Surely such a purpose is one in which the whole public is concerned.

"For these reasons, while accepting the rest of the report whole-heartedly, I dissent from the majority opinion recommending continuance of special federal automtive taxes."

(Signed) A. J. BROSSEAU.

UNUSUAL INCINERATOR FOR WASHINGTON PARK, CHICAGO

Washington Park, located in the middle of Chicago's great south side, is the city's third largest park with an area of 371 acres. It has beautiful lagoons where the residents of the city may indulge in boating in the summer and skating in the winter. This park has a dozen baseball diamonds, being better equipped for this game, probably, than any other Chicago park. Facilities for these diversions, and roque courts, an archery range, wading pool, sand courts, flycasting pond, tennis courts and a curling house, in addition, cause people to flock to it.

EXTERIOR OF INCINERATOR AT WASHINGTON PARK, CHICAGO.

At Washington Park, also, is located the Administration Building of the South Park Commissioners. The total area of the parks and boulevards under the jurisdiction of this board is 2,492.59 acres.

At such a large park as Washington, the job of disposing of rubbish and waste paper is a big one. The South Park Commissioners designed an unusual incinerator to handle the job at this park.

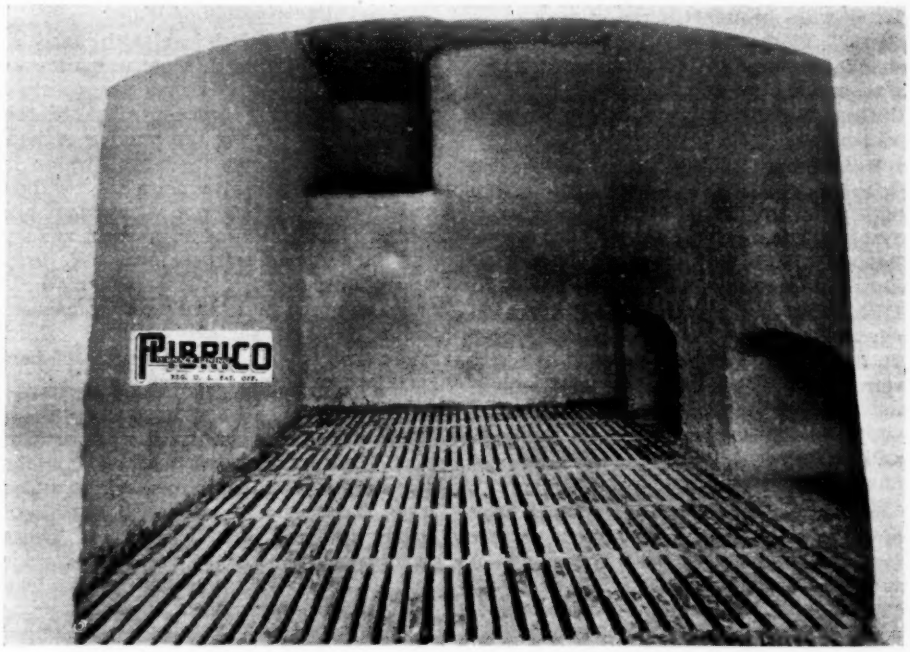
This incinerator was built at the base of the Washington Park Power House chimney. It was built of concrete and steel. The rubbish is dumped on the platform and then shoved in on the grate through the fire door. The rubbish inside the incinerator burns furiously be-

cause the high stack gives great draft.

The incinerator is lined with monolithic lining rather than with fire brick. Monolithic linings eliminate the joints that cause trouble where fire brick are used. With fire brick, the heat attacks the joints—bricks protrude, corners spall, walls bulge. With a monolithic lining there are no weak places, and so life is greatly prolonged.

Monolithic linings are pounded in while plastic with a mallet and are smoothed with a trowel. Anyone can make the installation; skilled bricklayers are not needed.

Plibrico, the jointless lining manufactured by the Plibrico Jointless Fire Brick Co. of Chicago, was specified by the South Park Commissioners.



INTERIOR OF WASHINGTON PARK INCINERATOR SHOWING THE MONOLITHIC LINING.

REVIEW OF WATER PURIFICATION FUNDAMENTALS

By J. B. Marcellus, Professor of Civil Engineering, University of Colorado, Boulder, Colo.

(Editor's Note: The following review of the elements of the art of water purification will be appreciated by the general reader and by those taking up the subject for more extended study.)

Pure water for drinking purposes has been appreciated by the human race from time immemorial. Wells of great antiquity may be found today in Egypt and India. Joseph's well at Cairo in Egypt is one of the most famous and was excavated in solid rock to a depth of 297 ft.

Ancient Works

The Egyptians were probably the first to purify their water. Turbid surface waters were filtered through unglazed earthen ware and muddy water was clarified by siphoning it from one vessel to another by capillary action of porous materials, such as strips of cloth.

The infiltration galleries of Athens, Greece, were probably built more than 2,000 years ago and the same method is still pursued today. Rome had the most elaborate system of water supply of any of the ancient cities. The supply came from four groups of springs through 19 aqueducts, the total length of which was 381 miles.

Until 1183 A. D. Paris obtained its entire supply from the Seine River, but as late as 1550 the supply amounted to only

1 qt. per capita per day. At the end of the 17th century Paris was using but 2½ qts. per capita per day. With such a limited supply one can easily imagine what the sanitary conditions must have been. In 1890, Paris was using 65 gals. per capita.

In London small quantities of spring water were brought to the city as early as 1235 by means of lead pipes and masonry conduits. In 1582 the first pump was erected on old London bridge for the purpose of supplying the city through lead pipes.

Boston was the first town in America to have public water works. They were built in 1652 and served to bring water by gravity from springs. Bethlehem, Pa., was the first to use pumping machinery, the operation of which began in 1754. The pump was made of wood (lignum vitae) and forced the water through wooden pipe into a wooden reservoir. The modern pipe was made by boring holes in hemlock logs. The spring which was used as a source of supply is still in use today, a record of 170 years of service.

As will be noticed since the early days of Rome, the underground water (springs) has been used as a source of supply. It may be termed 'instinct" that caused the "ancient engineers" to select underground water as the best source, as they know nothing of bacteriology. Bacteriology was not developed until 1876 by a man named Koch. The title "ancient engineers" is used as Frontius was a Roman surveyor and water commissioner, and in a work written A. D. 87, gives some interesting information concerning his various official duties. A translation entitled, "Frontius and the Water Supply of Rome," was made by Clemens Herschel, a prominent hydraulic engineer of today.

Wholesome Water

It has been through the hard work of the modern engineer that the citizen of almost any town of 1,000 population, or more, can get a plentiful supply of wholesome water by simply turning a faucet. One of the most difficult problems is to keep the water supply wholesome. Wholesome is defined as tending to promote health. The only pure water in nature is the rain as it leaves the clouds. As the rain drop approaches the earth it comes in contact with particles of dust; after it reaches the surface of the earth it is further contaminated and it may finally appear at the sewer outlet supporting discharged disease germs of a typhoid or tubercular patient. It is the problem of the engineer to find as wholesome a supply as possible and to keep it wholesome, or to provide proper means of purification if the supply is not wholesome.

Examination of Water

The American Public Health Association has standardized the examination of water so that comparisons are possible and the method of procedure will be the same. In testing for the number of bacteria one cubic centimeter of water is placed or planted in a glass (petri) dish and 10 cubic centimeters of cool agar are mixed, plated, allowed to harden, and incubated at body temperature, 37½ degs. centigrade, for 24 hours. The plate is now examined under the microscope and the number of bacteria counted. Good water will not contain more than 100 bacteria per cubic centimeter.

Bacteria

The type of organism is very important. The most common bacteria in the colon of man is the colon bacillus and a large number of such bacilli would, of course, indicate sewage pollution. These bacilli break up or decompose dextrose (sugar) and also produce acid. In testing for the colon bacillus some litmus solution is added to the agar in the glass dish or the water being tested is planted in dextrose water and the colon bacilli will attack the dextrose producing gas and alcohol. For standard purity not more than 1 tube out of 5 should show gas.

Of the millions of bacteria with which the human body comes in contact only a certain few are pathogenic or disease producing. When certain bacteria gain entrance to the human body and produce disease, the process is spoken of as infection. Whether or not infection occurs depends on the number and virulence of the bacteria. A small number may be overcome by the first onslaught of the defensive forces of the body. If the number of bacteria per cubic centimeter of water is limited to 100 or less it is assumed that the defensive forces of the body can overcome the small number of the 100 which may be pathogenic.

The process of purification of water has been so developed that the sewage from a town may be made as pure as the most wholesome spring water. Sewage is our used water supply. An exam-

ple of making pure water out of sewage is at Mt. Kisco, N. Y., a town of 3,000 people. Mt. Kisco is on the water shed of New York city's water supply. The raw sewage shows 1,480,000 bacteria per cubic centimeter (per teaspoonful) and the effluent from the sewage treatment plant shows 38 bacteria per cu. cr. This plant produces better drinking water from sewage than may be secured directly from the stream supplying New York City.

Water Treatments

Different waters require different treatments. The Mississippi River water is fairly pure, free from pathogenic bacteria, but is quite turbid or muddy. In St. Louis the water is mixed with lime to reduce the hardness and later with sulphate of iron and alum to form a flocculent precipitate which carries the sediment to the bottom of settling basins. If settlement is allowed for 24 hours, 95 to 99 per cent of the sediment and bacteria is deposited. Liquid chlorine is then injected into the water to make sure that the few bacteria remaining are destroyed. It has been estimated that over 50,000,000 people in North America drink chlorinated water.

This method of treatment is the result of 10 years of study and experiment on Mississippi River water by the engineers and chemists of the St. Louis Water Department. It is typical of many plants in the Middle West where surface water is used.

In the eastern United States, where population is more dense and consequently pollution more pronounced, more elaborate means of purification must be used. In the mountainous regions where population is thin and the water is taken from the upper sources, little or no treatment is necessary. The use of liquid chlorine as a germicide has become quite common on account of the ease of using and the beneficial results, whether the water be otherwise treated or not.

Filtration

As before stated, ground water is generally pure (wholesome). It may be "hard" on account of the dissolved minerals, but from a germ standpoint, it is generally good. This is, of course, due to filtration through a porous sand bed. If it is necessary to treat a surface supply, artificial filtration is used. Water which is filtered through a sand bed 3 or 4 ft. thick at the rate of 3.000,000 gals. per acre per day or 50 gals. per sq. ft. will have 97 per cent of the bacteria removed. Filters of this kind are called "slow sand filters." If the water is first allowed to settle for 6 or 8 hours with the addition of alum or some form of iron, and then filtered, about 99 per cent of the bacteria will be removed, as will also the "muddiness." If it then be treated with chlorine, the water will be practically sterile.

In order to increase the rate of filtration per acre per day, the rapid sand or "mechanical filters" have been devised. In the slow sand filter the bacteria themselves form a slimy and gelatinous coating on the sand grains and it is this coating which purifies the water or catches the bacteria. In the rapid sand filter this gelatinous substance does not have time to form and artificial substitutes may be used. The sulphates of iron and alum are generally used as a coagulant to form this gelatinous substance. In a rapid sand filter the rate is about 100,000,000 gals. per acre per day, and if given the same previous treatment as the slow sand filter, the efficiency is about the same.

While the first cost of the slow sand filter is more than the rapid sand filter, the operating costs of the rapid filter exceed the operating cost of slow sand filter. Many more devices, and more machinery, and labor are required for the rapid filter than the slow filter. The following shows comparative costs of a large number of plants. The figures are on the basis of 1 million gals. daily capacity.

	First Cost	Operating Cost
Slow sand	$32,600	$2.86
Rapid sand	12,100	4.04

In conclusion, the efficiency of any water treatment is measured by the effect on the death rate. While the common method of measuring the efficiency of any filter is to measure the bacteria removed, after all the death rate or the case rate of water-borne disease, is the crucial test of efficiency.

BETTER DISTRIBUTION OF PEOPLE AND INDUSTRIES

By John Nolen, City Planner, Cambridge, Mass.

(Editor's Note: Following is abstract of paper by Mr. Nolen before International Town, City and Regional Planning Conference at New York, April 22, 1925.)

A survey and study of existing conditions in this country and abroad brings to light many unfavorable results from the present methods of locating industries and distributing population. The subject is a complex one, but the examination of it has advanced sufficiently to justify the following conclusions:

1. That a better distribution of people is dependent to a great extent upon a better distribution of industries, because the industrial population and also the population that serves industrial workers must always tend to go where the industries are located.

2. That the industries should go more deliberately to those sections of the country where the maximum economic and other advantages are to be obtained. The result of such action would be to provide greater efficiency and economy in production, lower the costs for transportation and reduce the congestion of traffic. The location of many industries is determined in a rather haphazard manner through accidental causes, and once established, remains often, regardless of the advantages that would follow to the industry itself and to the general community from a change of location.

3. That within these regions of fundamental natural advantages industries should be encouraged in every possible way to locate away from the congested large cities, in already existing separate, small, self-contained cities, or in new cities, "Garden Cities," to be founded for the purpose. The twentieth century has provided facilities in the electric power station, the motor car, telephone and wireless communication, that tend to make life in new and relatively small communities almost as satisfactory from a commercial or cultural point of view as in a larger city.

4. That in the case of large existing cities an effort should be made by planning and zoning, first to disentangle the confused and unorganized parts of the city so that those parts that are capable of being made more or less complete in themselves shall be so planned and so regulated as to be more self-contained, and thus to provide more adequate localization for the life of its citizens and more favorable conditions for industry. But more important still, because of the greater opportunity, the growth and extension of the large city should be guided and planned and controlled in such a way as to form on the outskirts new sections almost as self-contained as separate, independent towns would be. These new areas would range in character from suburbs largely residential to satellite towns, the latter providing for local employment. In all cases, however, there should be local shop centers and markets, and as complete provision as possible for education, recreation and an agreeable local social life.

5. That economic, practical and permanently satisfactory solutions of the problems involved in the better distribution of industries and population can only be obtained through a wider application of the principles involved in city planning and regional planning. Such planning must be applied ultimately not only to existing towns and their extensions, to new suburbs, to satellite communities, to new "Garden Cities" to be deliberately and wisely located and planned, but also to the planning of states and wider regions. This work must be done with direct reference both to the needs of industries from an investment point of view, and to the needs of population and public welfare. Such a program should be based upon sound regional and municipal surveys and the patient gathering of the necessary data. In order to carry out such a program successfully there must be wider publicity of the merits of city planning and of the economic and other advantages that would follow from better methods of providing for the distribution of people and industries.

CITY PLANNING AS A PERMANENT SOLUTION OF THE TRAFFIC PROBLEM

By Arthur S. Tuttle, Chief Engineer, Board of Estimate and Apportionment, Municipal Bldg., New York, N. Y.

The ideal city plan should provide adequate accommodation for the circulation of pedestrian and vehicular traffic; light and air for the population; proper grouping of public buildings; suitable segregation of the various classes of business, residential and manufacturing areas; ample space for recreation; adequate rapid transit service; and readily accessible trunk line railroad terminals. If the city is located on a waterway, the plan should also include provision for the handling of water-borne commerce. The control of all these features of the City Plan, in this country, usually rests with the municipal

authorities and is exercised by a number of agencies.

In recent years, as the congestion problem has assumed serious proportions, the necessity of co-ordinating all of the factors which must be considered in the effort to accommodate the available means of communication to the ever-increasing demands made upon them and to an extent beyond their capacity, has resulted quite generally in the creation of City Planning agencies, with more or less official standing, for the purpose of adapting, in so far as possible, existing conditions to present day and future needs.

An Inflexible Plan Cripples Growth

If we could lay down fixed and inflexible rules as to the character and extent of development to be permitted in various parts of a city and its environs, if we could regulate the character and size of the vehicles of the future or even those of today, if we could anticipate the extent of the luxuries which the coming generation may afford, and if we could measure up the position which the city may acquire in its business, political and social relations, the city planner of today, on whom there rests a growing responsibility of tremendous moment, might perhaps lay down a plan which could be decreed as permanent. But suppose these things were done on a broad scale and with a careful study of the history of the past, what assurance would there be that the vision of the future would ever be realized, and if it should perchance, is the city to stop growing when the conditions for which it is designed have been met and thence evermore continue in a uniform existence? The answer to such a suggestion is that an unduly arbitrary and inflexible effort to direct the lines and character of the growth of a city inevitably cripples endeavor and destroys the initiative on which the growth or even the life of a city depends.

The growth of a city may be likened to that of a child. In the infant period the needs are few and in large degree identical. Through childhood days, as intellect develops and stature increases, the wants begin to multiply. There is an ever-increasing call for new clothing to meet the continuing growth of the frame, the social instincts must be cultivated and education must be acquired, and all of these usually make heavy demands upon the time and resources of the parents. Suppose, if you please, that the child ceased to grow either in stature or in mind, and imagine the grief of the parents and friends. To be sure, the requirements in this case would be comparatively simple, but the dream of future success and greatness would entirely fade away. And so it is with our cities as they go through the building-up process, only in their case so long as prosperity prevails, there can be no end to growth. The congestion which inevitably results is but the growing pains of the youth. Without it, prosperity is at low ebb, and the city is classified as dead.

No Permanent City Plan

To my mind, there is no such thing as a permanent city plan for the active, progressive and growing city, and the congestion problem must be considered as being ever present and as taking on a new character from day to day. We should aim to make our plan elastic enough to follow the change in business conditions, in methods of travel, and in habits, with as great vision of the future needs as can be safely depended upon from the lessons of the past. In other words, the city planner should direct his efforts no further into the future than he can justify from lessons of the past and he should not endeavor to extend his vision to a point where permanency could be implied, otherwise the resulting roominess might be likened to that which we note when we see the small boy endeavoring to wear his father's clothes.

Too much rigidity in plan would seriously interfere with changes which often spell a great economic and social betterment such as resulted from the substitution of electricity for steam in the operation of the Park Avenue Tunnel which was rapidly followed by the conversion of this avenue into one devoted to apartment buildings of the most exclusive type, or from the removal of the garment workers from the east side to modern loft buildings in the area north of the Pennsylvania Station which, up to a few years ago, was the center of the printing and lithographing industry, or from the transfer of the cloak and suit manufacturing industry from lower Fifth avenue to an area farther west.

The Plan of 1811

In the Borough of Manhattan we have an excellent example of a city plan which was developed in 1811 with such a far-reaching view into the future that

its promoters were subjected to serious criticism. In general, the north and south streets traversing the borough longitudinally were given widths of 100 ft., while the east and west streets, extending from river to river, were made 60 ft. wide, with an occasional street width of 100 ft. So generous were these widths, that later generations allowed these streets to be occupied by the structures which are today realized as encroaching seriously upon their usefulness and which would be removed at once if it were practicable to do so. The wider streets, in early days, did not prove to be as attractive for business as was the case with the narrower ones where congestion in some degree was noticeable, and no more than 25 years ago a street width of 100 ft. was actually deplored by an engineer who occupied a position of great responsibility in the municipal government and who, as a result of his personal study of the highway problem from every angle, ventured the opinion that the author of a plan providing for giving a street width of 100 ft. was enttiled to be hanged.

It was not until about 1903 that the inadequacy of our present streets began to be realized, and since this date there has been a continuous progressive movement in the direction of improving conditions at points of congestion.

The Motor Truck

To what extent the automobile is responsible for the present overcrowding of our streets is somewhat doubtful. While the motor-truck has largely replaced the horse-drawn truck, it does not ordinarily occupy as much space when standing still, and by reason of the fact that it is capable of moving, say, four times faster than the horse-drawn vehicles, it requires only one-fourth as much road space per unit of time while in motion. Similarly, the passenger car, which has superseded the buggy, is more economical of roadway space, as is also the taxicab as compared with the now obsolete two-wheeled hansom.

It is evident that the present types of vehicles are less of a tax upon the streets as regards space than were those of twenty or more years ago, and that the increased traffic congestion is due rather to the rapid increase in number of vehicles in use than to the change in motive power.

Another factor in producing congestion undoubtedly consists of the trend of the population away from the country to the cities, as is instanced by a comparison of the changes which have taken place in the last twenty-five years, the records indicating that in 1890 only 36 per cent of our population resided in cities, while in 1925 the ratio had increased to about 54 per cent. Probably this change, to some extent, has been brought about through the absorption of rural areas by the adjoining community, but at the same time it should be noted that the change has not been coupled with a corresponding increase of urban area by reason of the fact that in such areas there has been a continuing increase in density of population.

Before anything like definiteness can be reached in the laying down of principles for securing relief from congestion or for the replanning of our present-day city, consideration must be given to the future status of the motor-truck which at the present time is more popular than rail delivery for shorter hauls, partly by reason of the shorter time involved in transit and partly because of lower costs. Is the motor-truck to continue to hold its own as new rail facilities are provided, or will it come into even greater demand, with a corresponding increase in the load upon the streets?

The Airplane

Attention might also be drawn to the new conditions which are likely to arise through the increasing popularity of the airplane. This will demand the setting aside of great landing fields in the vicinity of our cities, from which new arteries of travel will have to be provided to connect with those previously planned, many of which, as a result of the changed conditions, may possibly be left outside the lines of popular travel.

In 1916 the first comprehensive zoning ordinance in this country was adopted for New York City, thus pioneering a movement which has since been followed by 320 cities, towns and villages, with a total population of more than 24,000,000 people, where more or less rigid zoning ordinances are now in effect.

The New York ordinances were designed partly to stabilize values and partly, in the language of the committee, "to promote the public health and welfare, including, so far as conditions may permit, provision for adequate light, air and convenience of access." In its report the Zoning Committee pointed out that street capacity was directly related

to the use of the property served, and that the lack of restrictions as to height at that time was bringing a continuous increase in traffic load as each new skyscraper was erected to replace a building of moderate height.

Building Heights

While height limits on buildings in New York City were then imposed ranging generally from 1 to 1½ times the street width, or in other words, say, from 60 to 250 ft., the skyscraper is still being erected to enormous heights under the latitude allowed through the provision of offsets under which the set-back above the governing height ranges from one horizontal to from two to five vertical.

Through the use of lots of substantial size, great towering heights are reached with the present-day buildings, sometimes with most attractive architectural effect and sometimes, in cases where space consideration is the only governing factor, with the effect of exemplifying the cubist's wildest dreams.

Reference might be made to a building now under erection in the downtown section of the borough, which, while located in an area where height at the street lines is limited to 200 ft., will nevertheless, in conformity with the set-back requirements, reach a height of 480 ft. This building will have 25 acres of floor space and accommodation for 6,000 employes, and will replace buildings ranging in height from 3 to 4 stories; its effect in bringing increased congestion not only to roadways and sidewalks in its vicinity, but also to transit lines is obvious, as is also the fact that the city planner of previous days could never have foreseen the resulting condition.

Manhattan Conditions

An examination of the zoning map for the borough of Manhattan shows that for purposes of use 12 per cent has been allocated to parks, 22 per cent to residence districts, 37 per cent to business districts, and 29 per cent to unrestricted use, while in the matter of height regulation 7 per cent of the area is limited to 1¼ times that of a street on which it has frontage, 63 per cent to 1½ times the width of the frontage street, 27 per cent is allowed twice the street width, and in the remaining 3 per cent of the area the height limitation is represented by 2½ times the street width. Assuming that the average street width is about 70 ft., and that the greater height allowances relate to the business and unrestricted areas it would appear that the average height of buildings in these areas would be about 140 ft. with a maximum of 250 ft. provided that no set-back allowance was made. From a very superficial view of the city, it is evident that we have a long way yet to go before anything like this average is reached, and that the congestion of today will be insignificant in comparison with that of the fully developed city unless radical steps are taken in the direction of affording relief.

The problem in New York is quite similar to the one which obtains in practically all of the great cities, not only in this country but abroad, and we are told that notwithstanding its wide boulevards, drastic traffic regulations are now being enforced in Paris, while the British Parliament has recently authorized a traffic commission with broad powers.

Suggestions for Traffic Relief

Actuated by insistent demands of civic organizations for an improvement in the present traffic conditions, evidently aimed more particularly at the situation existing in the borough of Manhattan, the Board of Estimate and Apportionment has recently appointed an Advisory Committee on Traffic Relief, consisting of the chief engineer of the Board of Estimate and Apportionment, the police commissioner, the corporation counsel, the commissioner of plant and structures, and an engineer from each of the five boroughs. At the present time the control and regulation of street traffic rests with the police commissioner; the responsibility for mapping, improving and maintaining the highways rests primarily on the presidents of the various boroughs, and the commissioner of plant and structures is charged with responsibility for the construction and maintenance of bridges and ferries. It was expected that this committee, which is made up of representatives of all of the agencies directly involved in an official way, would take cognizance of matters relating to the development of traffic arteries of an interborough character, and would formulate general policies for relieving or ameliorating traffic congestion. With a view of ascertaining the sense of the community and more particularly the views of the various organizations which have made the problem one of great concern, a public hearing was given by the committee a short time ago for the purpose of collating all of the suggestions which might be of-

fered as an aid in its investigation, at which time, however, practically no suggestions of value which could be construed as strictly novel were offered although most of those which have heretofore been under consideration were placed in evidence, these comprising the following:

1. The systematic control of street traffic, both vehicular and pedestrian, in which connection an effort should be made to bring about uniformity in traffic signs and signals throughout the country, with sufficient variation in control to meet the requirements of local situations.

2. The improvement of existing streets through the removal of obstructions, the laying of smooth pavements, the widening of roadways where practicable without undue encroachment upon the sidewalks, and the provision of easy curves at the intersections.

3. The introduction of by-passes to enable through traffic to avoid congested centers.

4. The limitation of the dimensions and weight of different types of vehicles.

5. The fixing of roadway widths to conform with the types of vehicles which they are likely to be called upon to accommodate.

6. The separation of grades at street intersections at points where this can be effected without undue property damage.

7. The construction of elevated express streets along the waterfront or where they can be introduced without undue deprivation of light and air or interference with surface traffic.

8. The provision of adequate parking accommodation for automobiles in or near the congested business and commercial centers, this being accomplished either by setting aside public areas for this purpose or through the construction either municipally or privately, of parking garages.

9. The placing of the burden of providing parking and loading spaces at least in part upon the property owners.

10. The widening of existing streets, where practicable, or accomplishing a similar result by the introduction of sidewalk arcades with a corresponding widening in the roadway.

11. The cutting through of new arterial streets where additional facilities can be obtained by no other method.

12. The control of density of traffic by imposing additional restrictions on heights of buildings.

13. Lowering the peak of vehicular traffic by compulsory night trucking.

14. The substitution, where practicable, of buses for surface railroads, and the removal of abandoned surface tracks.

15. The construction of underground rail facilities for the delivery of store freight.

16. The provision of undercrossings for pedestrians at the busy traffic points, preferably in connection with the operation of underground rapid transit systems.

17. The setting up of more liberal standards for the width of both local and arterial streets in the planning of new territory, or the assignment of a greater proportion of the city area to street purposes.

18. The acquisition of court yard areas during early stages of development which can later be thrown into the street system when and as required.

The field for study is a tremendous one and the expense which may be piled up, unless it is considered from a practical standpoint, is staggering. It is not to be expected that revolutionary results will flow from the work of the committee but rather that remedial measures will be carefully studied and that steps will be taken to apply those which are deemed most expedient.

As long as the inventive genius of man is permitted to function, its influence will be directed toward devising new and improved methods of transportation, and a glance over the past should be sufficient to convince us that unforeseen changes may within a few years render futile our best efforts to provide for conditions which we cannot anticipate with any certainty. On the other hand, however, a short-sighted policy which fails to provide for a reasonable growth is generally far more disastrous than is the comprehensive plan which falls short of meeting some of the requirements of future years by reason of altered conditions which could not possibly be foreseen. Both of these aspects must be borne in mind unless we are satisfied to be looked upon by our contemporaries as fantastic dreamers or by future generations as having been wholly lacking in foresight.

The engineer who, while endeavoring to plan for posterity, does not neglect his present opportunities and approaches

the problem with the assurance that his successors will, in the course of a few years, be engaged in revising his plan, to meet their needs, will accomplish all that can reasonably be expected of him.

The foregoing paper by Mr. Tuttle was read at the meeting of the International Town, City and Regional Planning Conference, April 20, 1925.

MODERN VIEWS ON SERVICE RESERVOIRS AND DESIRABLE PRESSURES

By A. C. Hutson, Assistant Chief Engineer, Committee on Fire Prevention and Engineering Standards, National Board of Fire Underwriters, 76 William St., New York, N. Y.

This subject involves two distinct features of water works practice, features moreover, which are not always related to each other. Nevertheless, in one important particular they are very definitely connected, as will appear.

It is, of course, a prime requisite of municipal water supply that its pressure be steady and uniform. This implies the taking of precautions to insure unvarying flow under any and all conditions whether routine or abnormal. And so, as a general rule, the most effective and at the same time least expensive means to overcome the inconveniences attending a sudden increase in draft is the provision of a service reservoir. Such reservoirs are found in many American cities.

Service Reservoirs

Usually they are located within or just outside the city limits and are connected with the distribution system by separate mains; that is, by lines other than those which carry the regular supply. Thus, fluctuations in demand can be cared for from the storage in the reservoir instead of by effecting a greater flow in the common supply line, for it is seldom possible to have supply mains of such a size that peak demand does not introduce a considerable reduction in pressure. Where these lines are long, this reduction may be serious for extended periods. Obviously then, service reservoirs which aid in the maintenance of pressure are highly desirable in cities whose water supply source lies at a considerable distance from the community.

As is the case with other features of water works design, the question of the use of service reservoirs and that of the pressure to be carried sometimes overlap. They may, indeed, even conflict; and therefore, the advantages of each must be weighed carefully and a proper balance struck for the particular city and condition concerned. Considerations other than necessary pressures, too, must be regarded, such as the most feasible site for a service reservoir, when two or more locations are available; the size of the mains, the proximity to high value districts, the cost of power and the efficient operation of pumping stations.

A reservoir constructed at a high elevation remote from the center of distribution will provide a higher initial pressure than a reservoir at a lower elevation at a less distance, but under maximum draft the relative value of these pressures may be reversed, as the friction losses in the shorter supply mains may permit a greater sustained pressure from the nearby reservoir, than from the one at the higher elevation.

Trend Towards Higher Domestic Pressures

As far as concerns desirable pressures, it is a fact that the demand for good domestic service alone often governs. Many of the older systems in the country were designed in accordance with this theory, with the result that the pressures adopted were relatively low, far too low for present needs. Today the trend is towards higher domestic pressures. In the past ten or fifteen years several of the larger municipalities have materially increased their normal pressures, and not only in their business districts, but in outlying sections as well. Notable among these are New York, Newark, Jersey City, Syracuse, Springfield, Mass., Buffalo, Providence, Louisville and New Orleans.

It is, of course, well recognized today that a water system whether privately or municipally owned, is a public utility and that any failure to provide the public with water at all times is certain to draw complaints and create general dissatisfaction. If this handicap to operation is to be avoided, then the water system must furnish an ample supply at pressures sufficient to assure suitable service at all regular elevations, even though excessive peak consumption rates may be reached very infrequently. Assuming, now, that the source of supply, whether gravity or pumped, is ample, it is obvious that the higher the initial pressure the better will a good domestic pressure be maintained at a satisfactory

figure during peak demands. Moreover, a high initial pressure will offset local losses due to partial clogging of service pipes to excessive lengths of conveyance because of wide streets, and to other conditions of a similar nature.

Disadvantages of Low Pressure

Some really large cities, such as Chicago and Detroit, have furnished a supply at a low initial pressure for many years from which circumstance it might be argued that the absence of general complaint in these cities—and in others wherein pressures average from 20 to 40 lbs.—proves that pressures as low as these are suitable for domestic consumption. Yet this is no proof. As in so many things, so in the matter of water pressures, what the general public knows nothing of, that the general public does not miss. Low pressures, however, do result in forcing owners of high buildings to install special pumping equipment and local water tanks, if they are to obtain a proper supply, and this "self-service," as it were, is costly. Furthermore, relatively low pressures often necessitate on the part of the water department, establishment of "booster" or special high service to take care of elevations above the average or to serve outlying sections where a satisfactory supply cannot be sent when pressures drop 10 or 20 lbs.

Fire Requirements

It is conceded today that one of the essential services performed by a water system is the suppression of fire, and few communities are any longer so purblind as to provide a system adequate for domestic purposes only. In point of fact, almost everywhere the first consideration relates to the potential demand for fire protection; this, and the insurance credit to follow the establishment of a good water supply. Water for domestic purposes usually can be obtained by the individual from wells or cisterns, and the first impetus for a water works system is generally due to a series of fires, or to the desire of some of the larger property interests to provide protection to their plants.

It is therefore evident that the question of pressures, as well as other features of the design of a water system cannot be decided solely from the standpoint of domestic service. Probably, in the average small town and in fact in any community where few buildings exceed in height 3 stories, 30 lbs. of pressure is ample for domestic service. Yet successful fire combat always entails the concentration of enormous quantities of water about individual buildings, even when the blaze occurs in a residential section. The amount of water so diverted far exceeds any normal domestic draft and to make it obtainable, either pipe of large size must be laid or else, if smaller mains are used, pressures must be raised high enough to overcome friction loss. Between these two requirements stands a mean, and this mean affords the ideal condition.

Changes in Fire Apparatus

In the past many cities, particularly those in the West, to which water had to be pumped, attempted to meet the situation by increasing pressures during fire emergencies. This measure, throughout the long period of the horse-drawn, steam fire engine, with its high cost of maintenance and operation, was satisfactory enough, since, with pressures at from 90 to 100 lbs., fire companies with hose wagons could run their lines direct from the hydrants. The modern fire department, however, with its motorized apparatus, uses a pumping engine instead of a hose wagon, and this can be purchased at a figure which is hardly prohibitive even to small towns. Times literally without number, automobile pumpers have proved eminently dependable; in fact, they far surpass the old steamer in their ability to deliver a large quantity of water continuously. It is therefore, held, nowadays, that the raising of pressure for fire fails to bring an appreciable economic advantage, while it does unquestionably introduce a material element of unreliability. Increase in pressure for emergencies means added stress, and other troubles are sure to follow the change in direction of flow following concentrated draft. This, and the water ram due to sudden shutting down of hose lines has resulted, in a number of instances in broken pipe lines.

Influence of Building Heights

The growing height of buildings in America is making it ever more difficult to furnish water direct from the hydrant at pressures which will give satisfactory fire service, unless special fire mains are laid. To reach throughout structures which are four stories or over in height, a pressure of at least 60 lbs. at the hydrant is necessary during such times as the full fire demand is being drawn. With the most advantageous layout of mains this means a normal pressure ex-

ceeding 75 lbs. As the number of buildings of four stories and higher increases, the fire flow is required at stronger pressures to give satisfactory service, and even then pumper capacity in the fire department must be provided for extreme heights, unless the remaining pressure attains to 150 lbs. or above as in a special fire main system.

Though the fire department may have equipped all companies with pumping capacity, it nevertheless is true that ability to deliver at least 10 per cent of the required fire flow direct from hydrants materially increases protection; if the fire apparatus can respond direct to the building and use a chemical stream from the large tank, after laying a line of hose from the hydrant to the fire. With suitable pressures this line can be used direct from the hydrant to back up the chemical line in case it is not sufficient to extinguish the fire. There is always delay when the fire engine must be connected to the hydrant before a good stream can be obtained. Therefore, the ideal fire service condition is one where pressures will permit a few hose lines to be used direct from hydrants, and which also will assure a continuously satisfactory flow under the heaviest demands, both domestic and fire, without dropping locally to less than 20 lbs. Twenty pounds is regarded as the minimum to which fire draft should be allowed to reduce pressures, for at 20 lbs. considerable friction loss can be overcome in the hydrant and suction hose and still have a positive pressure and not a vacuum on the pump of the fire engine.

The Automatic Sprinkler

Outstanding as a feature of modern fire protection in America is the automatic sprinkler. Without its aid the high conflagration hazard prevailing in most of the business districts of the town and cities of this country cannot be lowered. Buildings of large area and of the high combustibility common to ordinary wooden joist construction cannot be made safe for store or manufacturing occupancy, especially if 3 stories or higher, except by the installation of automatic sprinklers; the same is also true to a lesser degree of fireproof buildings if the contents are readily combustible. Mandatory requirements for such installations are embodied in the labor laws of numerous states and cities, and in the past year legislation has been introduced in one of the eastern states for compulsory sprinklering of apartment houses and hospitals.

Recognizing, then, that automatic sprinklers are essential, and that to be of value an ample and dependable water supply must be provided for them, and further, that for the individual to provide this water supply in each case the cost would be excessive—in view of all this, it is plain that modern water systems must be so designed as adequately to feed these systems.

Regulations for automatic sprinkler systems state that: "One or more connections from a reliable public water system of good pressure and adequate capacity furnishes an ideal 'primary supply.' A high static water pressure should not, however, be a criterion by which the efficiency of the supply is determined. The supply from city main should not be considered standard unless a hydrant test of the main capacity with at least 500 gals. a minute flowing indicates sufficient residual underground pressure to give at least 12 lbs. under the roof; this requirement of flow is the minimum for equipments having 200 heads or less in one fire area; larger areas will require additional flow in gallons per minute."

Analyzing this stipulation, it is apparent that the minimum pressure permissible, allowing 5 lbs. to a story, is, for—

	Lbs.
2-story buildings	22
3-story buildings	27
4-story buildings	32
5-story buildings	37
6-story buildings	42
7-story buildings	47
10-story buildings	62

To this must be added an allowable drop, due to the flow in the local mains; for a 6-in. main, 600 ft. long and fed both ways, the loss caused by a 500-gal. flow to a central point would be only about 1 lb., indicating that the above figures might be adopted as the needs of the system if sprinklers are to be supplied. But to be of full value this minimum of 12 lbs. on the top line of sprinklers, with a flow of 500 gals., should be available during periods of maximum consumption draft; an ideal condition would be to have this sprinkler supply available even at a time of heavy fire draft in an adjacent building. It is not always possible to build a distribution system such as to assure sprinkler supply under all conditions, but in determining upon the pressure to be carried it is reasonable to al-

low a material increase to care for losses due to peak consumption demand, or moderate fire demand, and also to care for a greater flow than this minimum of 500 gals.; this increase should be at least 100 per cent in the average city or town, giving required true static double the pressures indicated above for buildings of various heights.

It is not argued that pressures should be such as to care for all buildings in a community. It is reasonable, however, to provide for a building of normal or average height, which in most cities means 4 or 5 stories. It is therefore evident that a normal static pressure of from 60 to 75 lbs. is desirable for automatic sprinkler protection; such a pressure will also furnish good first aid hose stream protection from standpipes in buildings of 4 or 5 stories, and from yard hydrants about manufacturing plants.

Considering all features it appears that a pressure ranging from 60 to 75 lbs. is desirable as the normal static pressure in American cities, since this pressure will:

a. Supply domestic consumption to all except the highest buildings (over 10 stories).

b. Permit considerable fluctuation or lowering of pressure locally during peak demand without leaving extensive sections poorly supplied with water.

c. Insure quicker operation of the fire department, by allowing direct hook-up of hose lines with hydrants.

d. Assure effective sprinkler supply to a building of 4 or 5 stories.

e. Enable smaller service pipes to be utilized.

f. Afford more satisfactory flow for manufacturing processes requiring large quantities of water, for use in lawn sprinkling and for other needs.

Many existing water systems are functioning at materially lower pressures than the desirable one of from 60 to 75 lbs. Where supplied by direct pumpage, an increase is readily feasible; in some instances this would mean the cutting out of a standpipe or tank, but in a majority of cases these devices are of small capacity and are located near the pumping station; their main function has been to cushion the pump discharge. The need for them is slight, and they have been abandoned by many cities.

Effect of Increased Pressures on House Fixtures

Experiences, in respect to effect upon house plumbing and fixtures, in various cities where water pressures have been increased are highly significant. Here is some of the testimony:

In Springfield, Mass., pressures were increased in 1910 from 35 to 135 lbs. in the business district, and by the same or a somewhat lower amount throughout the city. Following completion of the readjustment the water commissioner reported for 1910 and 1911 in part as follows:

"Three serious breaks, one in old cement-lined pipe and two in mains and connections recently laid. Including the above, there was a total for the year of 73 leaks in mains and 226 service pipe leaks, with average cost of repairs of $51 and $5, respectively."

"During 1911, 32 leaks in mains and 113 in service pipes; average cost per leak, $19 and $7.50, respectively. Leaks generally attributable to the increased pressure which in many cases was where cement-lined or old light weight pipe had not been removed."

And these are extracts from a statement by Water Registrar Hathaway:

"The lower level, or downtown portion of Springfield was formerly supplied by the old low-service system which gave a maximum pressure of about 35 lbs. The large number of old tenement premises were located in this section. At that time the high-service supply from Ludlow gave a maximum pressure of about 135 lbs. in this lower portion, but was not used for these tenements because of the old and weak plumbing.

"When the supplies were both superseded by the new supply from Little River, with a maximum pressure of about 145 lbs. in the downtown section, it became necessary to replace the service pipes for this class of property with new and stronger pipes from the street main to the building. The cost of these services was equitably divided between the property owner and the water department. Pressure regulators were also installed between the new service and the old plumbing, the consumers paying only the actual cost of same to the department. In this manner, we overcame the objection spoken of, and the consumers having become accustomed to the new situation, we now have very little trouble."

In Syracuse, N. Y., which increased pressures in 1894 from about 45 to 90 lbs. in the business district and similarly elsewhere, the water department states

that, while no record of breaks was kept, not more than 3 or 4 ruptures could be charged to the increased pressure. Leaks in services and plumbing were too infrequent to be of much concern; troubles were practically over in less than a year. Similar increase in pressure was effected in the districts of Elmwood avenue and University Hill, early in 1910, by feeding from a new standpipe under an increased head of 47 lbs. In the 9 months following this change there were 4 breaks in mains and 4 service blowouts, and there is considerable doubt as to two of the former and three of the latter being due to increased pressure, as they occurred about six months after the change was made. With inferior lightweight plumbing, as was originally installed in these districts, the trouble experienced was surprisingly slight.

Elmira, N. Y., advanced pressure in 1912 from about 25 lbs. to 75 lbs. in the business district and similarly elsewhere. F. H. Shaw, engineer in charge of changes, reports only three cases where cast-iron pipe gave way and in all three there were indications of previous cracks. Numerous leaks or blowouts in plumbing, but no serious damage, were reported. The alterations were made during very cold weather and for two weeks many frozen services developed. Some of the breaks were doubtless attributable to frozen pipes rather than to increased pressures.

In the borough of Manhattan a number of changes from low to high service have been made during the past few years in order to secure a better supply to certain districts. Notice was given to house owners of the proposed increase in pressure, so that plumbing might be looked over and, if necessary, repaired. Very little trouble resulted. Similar changes since have been made in Brooklyn and the Bronx.

Albany, N. Y., in its business section increased pressures in 1910 from 60 to 90 lbs., with no resultant trouble; while Louisville, Ky., jumped its poundage from 40 to 70 in 1908 and reported similar freedom from difficulties.

Largely upon local conditions will depend the size, the kind and the location of service reservoirs. It may be taken as an axiom that service reservoirs are desirable under all conditions, if of such size that the contents will care for material fluctuations in demand or provide for fire flow when other sources are out of commission. But where the action is solely that of cushioning, the value may be negative, particularly if the elevation of the flow line is such as to preclude the carrying of suitable pressures.

For the village or small town, service reservoirs, standpipes or tanks may permit intermittent operation; the minimum storage under such a condition is that which will be necessary for fire demands during the time necessary to return the main source to operation. With allowance for depletion arising from domestic draft during the normal shutdown period, it is usually sufficient to provide for a 1-hour fire draft. Where, however, the storage is intended to provide part of the fire draft, even with the main service in operation, greater quantity should be provided. The minimum desirable in any service reservoir is a capacity equal to the fire demands for a period of 10 hours in places of over 2,500 population and 5 hours for smaller places; to this should be added a quantity equal to the peak hourly demands over the normal maximum day.

With further increase in size of service reservoirs various features of reliability of supply are at the same time cared for. Under all but the most exceptional conditions a storage equal to 5 days' consumption, at a maximum 24-hour rate, will assure a supply—especially with proper operation to conserve it—during the time required to repair a pump or other essential piece of equipment, or to fix a main pipe line. To offset the hazard of a non-fireproof pumping station, however, storage should equal 10 days' maximum consumption.

Service reservoirs are an element in the economical operation of a plant, but no definite statement can be given as to the saving which may result. With elevated storage equal to the fire demand and the excess due to peak consumption, the number of wells, in a system depending upon them for a source, need only be sufficient to furnish the maximum 24-hour rate of domestic consumption and provide for a sufficient number to be out of service for cleaning. In like manner, where the supply is filtered, the capacity of the filtration plant need only be equal to that of maximum daily consumption with one unit out of service. Equalizing storage enables the filtration plants to be operated at a uniform rate, which assures a better quality of water than when they are operated at varying rates.

Where the amount of water in storage is sufficiently large, the pumps can be operated at a capacity giving their maximum economic operation.

Elevated storage becomes almost a necessity where pumping depends upon electricity for motive power. It is theoretically possible to design and install generating equipment, transmission lines and other appurtenances to provide non-interrupted service, but records indicate that this is seldom accomplished. Where a service reservoir is not part of the system, reserve equipment, depending upon steam or internal combustion engines, must be provided.

Obviously, service reservoirs must be built substantially, and they should preferably be in two bays to permit cleaning and repairs. The location of the service reservoir is of vital importance. It may be taken as another axiom of water supply that elevated storage shall be either in the high value section of a city or beyond it, as viewed from the source of supply, since under these conditions fire and domestic demands at their peak will receive supply from two directions, with a minimum drop in pressure. Also it is desirable that this storage be as close to the higher values as the topography will allow. Equally true is it, moreover, that a single place of storage, connected by large mains to the high value district, is preferable to smaller segregated reservoirs with mains from each of sufficient size only to care for peak demands locally and a small percentage of fire demands in the high value districts.

Many cities and towns are built on relatively flat ground, with no adjacent elevation upon which to set a service reservoir with a high pressure gravity feed. But this need not interpose an insuperable obstacle if such a reservoir is really needed. Recent advances in the construction of steel tanks and reservoirs, particularly in the oil trade, where containers of from 1,000,000 to 5,000,000 gals. capacity are becoming very common, makes it possible for these level cities to provide storage. With a height of 35 to 40 ft., a tank of 2,300,000 gals. capacity, which is a standard size, can be erected for approximately $40,000; and this includes a steel top, which may not be necessary for water works use. Such a tank, erected even 100 ft. above the main values of the community, will assure a degree of service well worth the expenditure.

In conclusion let it be repeated that desirable pressures range from 60 to 75 lbs.; that the raising of pressure above these figures for fires is undesirable and introduces a hazard; and that the introduction of service reservoirs add to the adequacy and reliability of a system—although it must be remembered, the use of auxiliary reservoirs can never justify carrying on the regular water supply a pressure lower than 40 lbs.

The foregoing paper by Mr. Hutson was presented at the 1925 meeting of the American Water Works Association.

NEW YORK CENTRAL'S USE OF TRUCKS AND UNIT CONTAINERS

By G. C. Woodruff, General Freight Agent, New York Central Railroad.

(Editor's Note: The address reproduced herewith was delivered by Mr. Woodruff before the National Retail Dry Goods Association at New York, Feb. 11, 1925.)

Railroad use of motor trucks, while comparatively new in its present form is really but the modernizing in many of its activities of similar undertakings, many years ago before motor trucks were even dreamed of. The handling of so-called L. C. L. in merchandise traffic has for years presented a problem particularly in larger cities and most of all in New York.

In the aggregate there was a large bulk of freight to be moved in many units of different sizes, shapes, density and weight, and presenting many different degrees of fragibility and susceptibility to claims for loss and damage.

It was offered at all of the numerous freight stations and piers located conveniently around the city and because it could not be gotten together and loaded in proper cars from some one point it was necessarily loaded in a car from the station offered to some transfer point up the road and there rehandled, either to another transfer or in some cases loaded in a car which would carry it to its destination.

In the days of relatively cheap labor and other railroad expense the actual "out of pocket" cost was not so much the important factor as was the poor brand of service offered with consequent dissatisfaction.

As a result considerable quantities of the merchandise for the more competitive points was transferred to central loading points and there put into straight destination cars. This method, however, was both expensive and unsatisfactory and after a time was discontinued.

With the coming of the motor trucks as known today, with heavy tonnage per load, most modern equipment and quick trips between stations, the opportunity again came for both relieving transfers and improving the service at a lessened cost per unit.

Twenty-nine Cars Daily Freed from Transfer Service

As illustrating the possibilities and actual results at a large center let me mention that at New York alone this railroad did away with some 29 cars per day heretofore loaded on West Albany Transfer and by trucking the freight to proper concentrating points has been able to make many additional straight cars to points which could not otherwise expect such service. This has turned out most satisfactorily, both to the railroad and shipping public, for in actual practice it makes it possible for the shippers to bring their small shipments to the station most convenient for them with the assurance that it will receive service equally as good as though it had been trucked a long distance to one of the larger stations. This is but one of the trucking activities but from the standpoint of the retail merchant is of primary importance.

Again, in sections of the railroad where the towns are small and the tonnage light such freight has in the past been handled in so-called "way freight trains," that is by trains which stop at every station on the way to unload a load of freight by the train crew. With the generally light tonnage and the high expense of operation for such a train the motor truck came into the picture.

Now a motor truck (or trucks) is actually the way freight on the highway and leaves and picks up freight at the small stations in quite the same way except that the time is improved and the operating cost materially reduced.

A further activity is the handling of freight interchanged between railroads at junction points by motor truck rather than by loading in a car and switching.

Take as an illustration, Buffalo and the interchange with the Pennsylvania Railroad.

To handle by railroad car switching means at least five switch movements and great delay and increased congestion when business is running heavy. To handle by motor truck means one handling and a run of less than one-half hour between terminals. The improved service and economical handling here need no comment. Such is the practice at most of the important interchange points on this railroad and the experience of a year or more makes us convinced the practice is sound and to be continued.

The loading of freight from a large central transfer point into a car to another center and from there distributing by motor truck to the small receiving stations is another activity. This in a sense is the reverse of the activity first mentioned but permits of equal service being rendered the smaller points and in addition makes for economy in cars handled and tons of freight transferred in units.

The handling of freight by motor trucks in lieu of lighterage is another illustration. This is principally done at New York in order to take care of freight which can be handled more economically by truck than by using the marine or floating equipment and it serves as an efficient and worth-while relief, particularly in times of congestion or severe winter weather.

Not Competing with Truck Concerns

In the brief time allotted to me I can at best but merely mention these principal activities which from small beginnings spread to large proportions, for on the New York Central Railroad proper there are at present some 65 to 70 separate activities in the use of motor trucks practically all included in the six heads I have mentioned and covering the principal points served by this railroad. To attempt to enumerate them here would serve no purpose, but it may be of interest to note in passing that each and every one of the arrangements has been made with and is now being carried out by a trucking concern already established in business and that in no instance has there been any attempt to disrupt a going concern.

I mention this particularly because there has been so much said and written as to the competition between the railroads and motor trucks.

As applied by us there is, however, no competition in any true sense of the term, but rather there is close cooperation in an endeavor to ascertain and make use of

the proper sphere of motor trucks and they and the railroads each undertake to do that part of the transportation which they are individually best fitted to perform.

It is our view that if in its own way motor trucking as an individual thing, but, more important, motor trucking as an organized activity, would devote its efforts along the same line rather than by fostering unwise and unneeded motor truck activities and thereby disrupting already established trucking operations and in addition creating false ideas as to costs, the true advancement of motor trucking, not merely its use by the railroad, but by industry as a whole, would be very greatly assisted.

I appreciate this is not directly in line with my subject, but nevertheless it is important to you as clear thinking men of affairs particularly posted as to transportation.

Railroads to Expand Greatly Their Truck Use

There is in my opinion enough opportunity for legitimate expansion of the use of motor trucks by the railroads to cause the motor truck industries to "Stop, Look and Listen," and I sincerely trust a decision will be reached that a mere showing of increased sales is not the true test of achievement but rather the encouraging of motor truck expansion along sane, constructive and permanent lines which will not break down legitimate activities but rather build them up and cause them to increase.

There is a field for the motor truck in railroad activity and that field is a very large one and has only just been entered upon in a small way.

The motor truck has its limitations and these like all others might just as well be recognized, for during the past few weeks in certain sections it has of necessity been forcibly brought home that "good old Dobbin" is after all a very reliable form of transportation even as compared with both trucks and the railroad.

Based on nearly two years of extensive and constantly extended use, I am more than ever of the opinion that the use of motor trucks as important aids to and adjuncts of railroad activity will develop even more rapidly in the near future than in the immediate past, but I am equally of the opinion that the railroad as such is not fitted by equipment, experience or personnel to undertake to organize and operate its motor truck activities but that these might better be undertaken through already established trucking agencies on a contract basis.

The seventh and last truck activity is the one covered by the second part of my subject, namely, "the use of unit containers," and constitute what I may call coordinated service between railroad and motor truck.

This activity came as a direct result of the need of some method of transportation which would have as its primary result the elimination or at least material reductions in freight claims for loss and damage on high-class merchandise traffic.

New York Central's Container System

To the vision of our late President Mr. A. H. Smith, is due the idea from which the merchandise container came and to him also is due the credit for the long period of experimentation and working out of the plan.

Visualize if you will a steel box weighing about 3,000 pounds and having a capacity of 438 cubic feet with a weight carrying capacity of 7,000 pounds, with inside dimensions of length 7 feet and width 8 feet 10 inches, and a door opening of 5 feet 9 inches by 3 feet 6 inches, weather tight, and a door of standard refrigerator design, equipped with a locking device upon which shippers can put their own private locks. Six of such containers are handled in a specially equipped open top car and when loaded upon the car can not be opened.

The handling to and from truck and car is done by electrically operated crane furnished by the railroad company without charge.

All classes of merchandise (except certain prohibited articles) may be shipped together in a container, their total weight being shown as container ....., weight of contents ..... pounds, and billed at specified rate per mile.

Here there is a radical difference as compared with the usual method of shipping by Off. Class. at so many cents per 100 pounds for the class requirements as to packing do not have to be complied with.

How Rates Are Figured

The rates are figured on a base rate per mile at a minumum tonnage of 3,000 pounds and are then stepped up one-quarter cent per mile for each 500 pounds of additional tonnage until the maximum of 7,000 pounds is reached.

For example—a base rate of 4½ cents per mile for 3,000 becomes 6½ cents per

mile for 7,000, and it will be noted that the tonnage has been increased two and two-third times, while the rate has only been increased about 50 per cent—in other words the resultant rate translated in the ordinary terms of cents per 100 pounds decreases as the tonnage increases—which has the effect of better tonnage per container.

The containers are handled to and from railroad yards by shipper's or consignee's trucks or when desired by outside trucking concerns who have made a specialty of this new method, their rates only charging for the weight of the contents and not for the container itself.

For shippers or receivers who cannot conveniently ship even the minimum of 3,000 pounds themselves the service is available through forwarders at all the points where the service has been established, and who make a business of shipping consolidated containers and picking up or distributing the individual package as may be mutually arranged.

From small beginners bi-weekly between New York and Buffalo in October, 1922, the undertaking has expanded until now there is daily service between New York, Utica, Syracuse, Rochester and Buffalo and further plans for expansion are being worked out.

Has Eliminated Pilferage and Damage

Briefly it has solved the pilferage question—for there can be none. It has practically solved the damage question; it has reduced transportation costs and makes possible radical economies in the cost and weight of packing cases. There are other important contributary advantages for it presents the satisfactory situation of a new method of transportation which benefits shippers and receivers and the railroad as well.

To those of you who have especial interest in this unit container I would be glad to have some further word so that your particular business may be gone into and we would be pleased at any time to furnish information as to just what is being done and appreciate suggestions towards improvement.

After all the railroad has but one thing to sell and that one thing is "Service" spelled out in capital letters. The primary service duty is to transport an article of merchandise from one point to another and there make a satisfactory delivery, but in railroad activities of today it has a much wider scope and is very far reaching.

It means literally "To Serve" by doing anything no matter how little or how big that will contribute to the upbuilding of a community, increase the welfare of an industry or contribute to the peace, happiness and prosperity of the individual or the communities served.

This is what we and all other railroads are trying to do and any method of improved transportation, be it motor trucks, unit containers or what not, contributes its share towards the perfected transportation machine.

There are many things important in their influence on the life of a community and individual—fertile lands, pure running rivers, educational advantages and so on—but study if you please the progress of nations during the past two hundred years and history will tell you that the nation whose transportation facilities expanded and grew in the greatest degree is the one whose industrial and individual welfare and well being has gone forward with such marvelous strides. That nation is our beloved United States and transportation has played no small part in that advancement.

It has been true for years and is true today and will be true for the years to come and keeps ever true the inscription over the Great Golden Door on the Transportation Building of the Chicago Exposition, which said, "The easy progress of men and things from place to place makes a nation strong and great."

RESURFACING FIFTH AVE., NEW YORK, AND BROAD ST., NEWARK, WITH ASPHALT

By J. W. Howard, C. E., Consulting and Testing Engineer, 1 Broadway, New York, N. Y.

(Editor's Note: Portions of Fifth Ave., New York City, and Broad St., Newark, N. J., were resurfaced in the summer of 1923 with asphalt pavement of the most modern type and substantially the same materials. Mr. Howard in the following paper, which was read before the Philadelphia Engineers' Club on February 20, 1924, presents typical selections from his analyses and tests of daily mixtures used in the asphalt binder and sheet asphalt surface layer, the object in this work being to construct a very durable pavement which can be maintained indefinitely in good, usable condition. These are heavy traffic streets. The paper shows

what is probably the latest and best practice in constructing dense, tough and durable sheet asphalt pavements.)

The location on Fifth avenue is between 42nd and 59th streets, which was paved, replacing granite blocks, with asphalt in 1896 and well maintained for 26 years, until repairs to underground pipes and conduits and the widening of its roadway by setting back the curbstones compelled this reconstruction. The traffic is enormous, consisting of passenger vehicles, including 2-story auto buses.

The location on Broad street, the principal business street of Newark, is between Kinney and Walnut streets, near the city hall. It was paved in 1914 with creosoted hard pine wood blocks, replacing granite blocks. The traffic is enormous and of greater tonnage than on Fifth avenue, because of the large number of commercial trucks of that city and the steady flow of express and freight trucks on their way between New England cities, New York City and Philadelphia, Baltimore and vice versa. The wood block pavement on good 8-in. concrete base had been maintained with increasing difficulty and expense for 9 years, until 1923, when the damage of weather and traffic made the expense of repairs too great to continue using wood; in 1923, $4.42 per each sq. yd. of wood renewed on the old good base.

The city decided, as a matter of economy and efficiency, to replace the wood blocks with asphalt binder and surface layer, using its existing good base, doing this by sections as fast as sections were beyond repair with wood. The work was done by the city asphalt paving plant, under the direction of George W. Andress, engineer in charge of Bureau of Streets of Newark; a bureau of the Division of Works, J. W. Costello, division engineer.

It was necessary to use from 2½ ins. to 3 ins. of binder and 1½ ins. of asphalt surface layer, to fill the 4 ins. of depth of the removed wood blocks and some of the ½-in. of cement-sand cushion under the wood blocks. The cost of removing the old wood blocks, their cushion, and laying the asphalt binder and surface layer was about $3 per sq. yd.

On Fifth avenue, the irregularity of the top of the old concrete base required binder layer from 2 ins. to 3 ins. thick, to furnish a uniform surface for the sheet asphalt wearing surface layer, which was made only 1 in. so as to be rigid and eventually more easily and economically maintained without disturbing the dense, stable binder layer under it. The Fifth avenue work was done by contract, by the lowest bidder, C. D. Beckwith, Inc., under the supervision of the Department of Public Works of Manhattan borough.

For Fifth avenue and Broad street, all the materials and compositions of asphalt binder and of surface layers were practically the same except that for Fifth avenue the consistency or penetration of the asphalt cement was 35 (0.35 cm.) while for Broad street, it was 45 (0.45 cm.). For both pavements, the crushed stone for binder was hard dolomitic limestone, the sand moderately sharp, selected carefully graded sand; the same sand as used in the asphalt pavement surface layer. Portland cement was used as the filler and to add stability to the surface layer. Mexican asphalt cement from Mexican asphalt-base petroleum, was used in the binder and top layers.

Two heavy tandem steam rollers of about 14 tons were used on each, one lengthwise and one crosswise, except that used in Newark, a third of heavier weight, 3-wheeled (macadam type) roller was also used on the binder layer.

The specifications, briefly stated, required the composition to be within the following limits:

For Binder Layer	New York	Newark
Bitumen (asphalt cement)	5— 8%	4— 7%
Mineral Passing 10-Mesh Sieve	25—40%	15—30%
Mineral Passing ½-inch Sieve	20—45%	20—50%
Mineral Passing ¾-inch Sieve		15—65%
Mineral Passing 1-inch Sieve	25—55%	
Mineral Passing 1¼-inch Sieve	0— 4%	
Penetration of Asphalt Cement	30—40	45—55
Actually Used	35	45

For Asphalt Pavement Surface Layer	New York	Newark
Bitumen (asphalt cement)	10—12%	10.5—11.5%
Mineral Passing 200-Mesh Sieve	15—25%	15—25%
Mineral Passing 80-Mesh Sieve	20—35%	20—35%
Mineral Passing 40-Mesh Sieve	20—45%	20—45%
Mineral Passing 10-Mesh Sieve	15—30%	15—30%
Penetration of Asphalt Cement	35	45
Filler to be	Portland Cement	Portland Cement

New York requires voids in the finished surface layer to be not more than 7 per cent by volume.

Newark requires the density (specific gravity) of the fully compressed sheet asphalt pavement to be 2.2; an excellent direct test.

The asphalt cement tests of the specifications, when reduced to tabulated form, especially in Newark, show the qualities any asphalt cement must have to be good, without reference to brand of origin.

Asphalt Cement Tests	New York	Newark
(a) Contains no water	None	None
(b) Be homogenous	Yes	Yes
(c) Not affected by water	No	No
(d) Ductility at 77 F. at least	50 cm.	40 cm.
(e) Specific Gravity at 77 F. at least	x	1.00
(f) Penetration at 77 F.	30—40	45—55
(g) Flash Point, open crucible, at least	350 F.	400 F.
(h) Loss at 325 F. in five hours, not above	3%	3%
(i) Penetration of Residue after (h); % original at least	50%	60%
(j) % of bitumen of A. C. to be soluble in CCl^4 at least	98.5%	99%
(k) Purity of bitu. by solubility CS^2 not vary more than	x	0.5%
(l) Cementing Strength, Howard method at 77 F. to be per square inch, at least	x	25 lbs.

Note: x means no requirement for these tests.

The writer was called upon by the contractor in New York and at the same time by the city of Newark, to test the materials for the mixtures, set the precise proportions for binder and surface mixtures, and make daily analyses and tests while both pavements were being laid. The only difference was in the requirements for the gradations of the sizes of binder stone. The qualities and the gradations of the crushed stone, sand and portland cement for filler, also the qualities of the two asphalt cements having been tested in his pavement testing laboratory, the proportions of stone, sand and asphalt cement for the practically voidless, dense and stable binder were calculated and laboratory samples made and tested; likewise with the materials and proportions for the sheet asphalt surface layer mixture.

The binder mixtures set by the writer, for the two paving plants were as follows:

	New York	Newark
Asphalt Cement, Mexican, pure bitumen	5%	4.7%
Sand, 200 to 10-mesh	27	21 3
Crushed Stone, ½ to 1-in.	68	74
Total Weight	100%	100%
Penetration of Asphalt Cement	35	45

Typical daily analyses and tests of binder mixtures were as follows:

	July 13, 1923 New York	July 17, 1923 Newark
Bitumen (asphalt cement)	5.1%	4.7%
Mineral Passing 10-Mesh Sieve	27.3	22.1
Mineral Passing ½-in. Sieve	26.0	35.2
Mineral Passing ¾-in. Sieve	—	38.0
Mineral Passing 1-in. Sieve	41.	—
Mineral Passing 1¼-in. Sieve	0.6	—
Total Weight	100%	100%
Bitumen Coating on grains	Thorough	Thorough
Density of fully compressed mixtures	2.42	2.44
Compressed test cylinder broken by impact at 77 F.	Tough	Tough

The sheet asphalt surface layer mixtures set by the writer for the two paving plants were as follows:

	New York	Newark
Asphalt Cement, Mexican, pure bitumen	11.%	11.%
Portland cement, filler (80% passing 200-mesh)	14.8	16.
Sand, 200 to 10-mesh	74.2	73.
Total Weight	100%	100%
Penetration asphalt cement	35	45

Typical daily analyses and tests of the asphalt surface layer mixtures were as follows:

	July 11, 1923 New York	July 21, 1923 Newark
Bitumen (asphalt cement)	10.7%	10.3%
Mineral Passing 200-Mesh Sieve	15.1	16.3
Mineral Passing 80-Mesh Sieve	20.	20.
Mineral Passing 40-Mesh Sieve	38.9	42.7
Mineral Passing 10-Mesh Sieve	15.3	10.7
Total Weight	100%	100%
Pat stain test	Good	Good
Bitumen coating on grains	Thorough	Thorough
Density of fully compressed mixture	2.173	2.216
Voids in compressed pavement	5.6%	3.7%
Penetration of Asphalt Cement	35	45

The thick binder layer was spread at 265 to 275 F. and rolled to practical ultimate density and with surface not quite smooth, so the asphalt pavement surface layer would firmly bond with it as well as adhere when spread 285 to 295 F. and completely compressed on the clean binder surface. The resulting pavements on Fifth avenue and Broad street are such that the surface layers in future years can be kept in constant good condition indefinitely, without disturbing the binder layer, by a little prompt attention from time to time.

ELEVATED TANK CONSTRUCTION

By George T. Horton, President, Chicago Bridge and Iron Works, 37 W. Van Buren St., Chicago, Ill.

While I naturally felt very much honored upon being invited to address the Illinois Society of Engineers upon the subject of "Elevated Tank Construction," I wish to add that the invitation had a particular appeal inasmuch as my deceased father, Horace E. Horton, addressed a former meeting of this society on the same subject twenty years ago.

Less than a month before receiving the invitation to address you, I had in mind to prepare a chronicle on the evolution of elevated steel tanks, and althongh there has not been time to secure the data I am endeavoring to obtain, I believe you will be interested in what I do know on the subject from personal recollection.

My father had much to do with the introduction of elevated steel tanks of the types now so generally used. However, the honor of original conception of an elevated steel tank with a self-supporting bottom belongs, I believe, to Edward Flad, C. E., now practicing in St. Louis, Mo.

The first design of an elevated steel tank I remember seeing was illustrated in a book entitled "Framed Structures" by Messrs. Johnson, Bryan and Turneaure, which I obtained in the fall of 1893. A chapter of this book was devoted to the design of standpipes and elevated tanks, and therein was illustrated a steel tower and tank built at Laredo, Tex., from Mr. Flad's design.

Mr. Flad has written me that the idea of a self-supporting bottom was entirely original with him; that he prepared designs as early as 1887 for similar structures which for various reasons were never built. He states in his letter that he presumes the same thought had probably occurred to others, and I do know that in a German engineering periodical of 1886 designs of elevated tanks were illustrated, the bottoms of which while self-supporting, were composites made up of a combination of cones and spheres. To Mr. Flad, therefore, I feel we owe great homage.

Our First Standpipe

In the summer of 1893, only a month or so after graduating from college, I was called upon to act as foreman in charge of the erection of our first standpipe, built at Lake City, Iowa. We were in the bridge business those days, as our names indicates—which incidentally we have never yet had the courage to change—and where or how we secured the contract for this standpipe I do not know. It was, however, characteristic of my father, a natural builder, to stray from set paths. How he had learned as

FIG. 1—ELEVATED STEEL TANK AT LAREDO, TEXAS, DESIGNED BY EDWARD FLAD.

much as he apparently knew at that time about standpipe construction I do not know, but in the light of over thirty years' experience, I do know that that standpipe was essentially right in all of

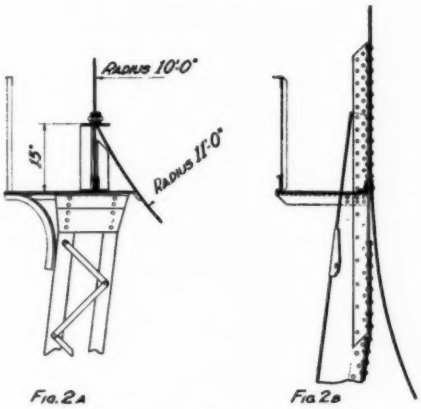


FIG. 2a—METHOD USED BY MR. FLAD TO SUPPORT LAREDO ELEVATED TANK.
FIG. 2b—TANK CONNECTION WITHOUT SKIRT, DESIGNED BY HORACE E. HORTON.

its major and in most of its minor conceptions.

I was chosen to act as foreman, naturally not because of any ability or experience, never having seen a tank, but solely because we wished to avail ourselves of the services of two experienced workmen skilled in water tight work then in our employ, neither of whom we knew could boss the other. About all I like

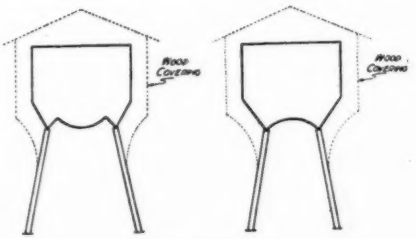


FIG. 3—TANK DESIGNS DISCUSSED BY A GERMAN ENGINEERING PAPER IN 1886.

to acknowledge is that this standpipe was completed. I do not think that one single thing still remains of the construction methods I adopted at that time. It might well be cited as an argument for the theory that "anyone can do anything."

The building of this standpipe first opened our eyes to the field of tank construction. Our sales organization, such as it was, was engaged in securing contracts for municipal bridges and consequently all of our earlier tank orders were municipal standpipes where lettings were regularly advertised. Concurrently we, as structural steel builders, had erected steel towers for the support of wood tanks, a type of structure used quite extensively thirty to thirty-five years ago.

The Original Dished Plate

After finishing my job as foreman on our first standpipe, I was engaged in the preparation of designs and estimates both of standpipes and these towers, and at that time I first saw the book in which Mr. Flad's design of the Laredo tank appeared. I showed it to my father who stated almost immediately that we could build such a tank. Evidently the idea took root as I found him the next day experimenting on a method of forming the plates necessary to construct a sphere. I am sure that his idea of the method of performing this particular operation was entirely original and to this

FIG. 4—FIRST ELEVATED STEEL TANK BUILT BY CHICAGO BRIDGE & IRON WORKS AT FORT DODGE, IOWA.

day we have not changed the same, although we have enlarged our machines. His thought was that a plunger impinging upon a plate supported on a solid ring of larger diameter than the plunger, would buckle the plate in that particular spot, and if the plate were gradually moved under the plunger it would take on spherical form. The original piece of plate on which he experimented still hangs in our office.

FIG. 5—SECOND ELEVATED STEEL TANK BUILT BY CHICAGO BRIDGE & IRON WORKS AT PARIS, ILL.

This method allowed the plates to be formed cold. It does not require special dies, and produces remarkably accurate results. It marked one of the big steps forward in the evolution of steel tanks.

Having satisfied ourselves that we could so form plates, we prepared some designs and shortly afterwards in the summer of 1894 we received our first order for a hemispherical bottom tank to be erected at Fort Dodge, Iowa. We did not realize at the time what a great event that order really was. These days in some of our meetings I have a little fun with our salesmen in referring to the fact that we did not even have a representative at the letting when this eventful order was given us.

We had trouble aplenty to build this first tank of ours and while from a construction standpoint the tank was a great success, from the point of view of an auditor, it was a fearful disaster.

Column Connections

Another improvement in the design contributed by my father consisted in the method of attaching the supporting column to the tank. Mr. Flad in his design carried the shell of the tank some distance below the connection of the hemisphere, forming a sort of skirt. At the bottom of this skirt he attached two angles similar to the flange angles of a plate girder, which took a bearing on the top of the columns. He divided the top of each column into three prongs in order to make additional supports. On our very first tank my father did away entirely wtih the pronged columns and the skirt. He fastened the columns to the vertical side of the tank by means of rivets passing through the shell and connection angles attached to the side of the column, and added a balcony girder at the connection of the hemisphere to take the horizontal thrust induced by the inclination of the columns. The great advantage of these changes was that everything was accessible. In the original design the space between skirt and bottom was almost inaccessible, in fact if the bottom were a full hemisphere —another contribution of ours—a certain amount of space would be entirely so.

In this particular detail, attachment of column to tank, I think my father's boldness as a designer—quite characteristic of him through all his life—appears vividly. The connection necessitates cutting off on a bevel the upper portion of the column and supporting the tank entirely by means of rivets passing through the shell and connecting angles on column. The loads are heavy and it is often necessary to stretch out the rivets needed over a distance of some six or eight feet. I remember very well that certain colleagues of his criticized this detail, stating that the rivets would not take equal loading, that some would shear off, thus putting greater load on the ones adjoining which would in turn shear and eventually the whole thing fall.

My father apparently felt entirely sure of his position, refused to accept their criticism and made a remark at that time which has served us all in good stead

many times since. He said that if a rivet in a tank is overstrained, leakage will occur long before it will fail and consequently plenty of warning is given

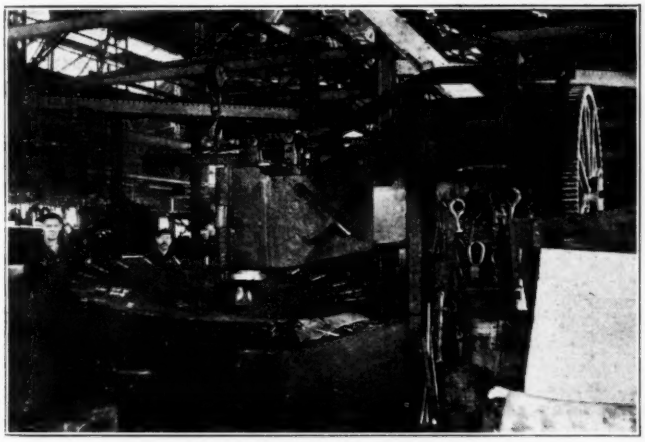


FIG. 6—THE DISHING MACHINE DEVELOPED BY THE CHICAGO BRIDGE & IRON WORKS FOR SHAPING BOTTOM PLATES COLD.

that overstrains are taking place. Only a moment's reflection shows us how sound is this argument. Oftentimes I have used it in discussions in reference to riveting, particularly when altercations arise upon the old, old question of whether a certain rivet is tight or loose. If a rivet is loose it will leak and settlement of the controversy need only await the filling of the tank. In my connection with shipbuilding during the war I used this reasoning to settle some rather tense situations which arose in the early days between inexperienced foreman and inexperienced inspectors, the rivets in question being in the tank and double bottoms of the ships, all of which were to be filled for testing before launching.

Laredo Tank Well Proportioned

The following illustrations will perhaps amplify the preceding—Figure 1 is a photograph of the Laredo tank which we all must admit is a good looking, well proportioned structure. The picture shows the additional supports under the tank, accomplished by diagonal struts leading away from the main column at the level of the top horizontal strut. To

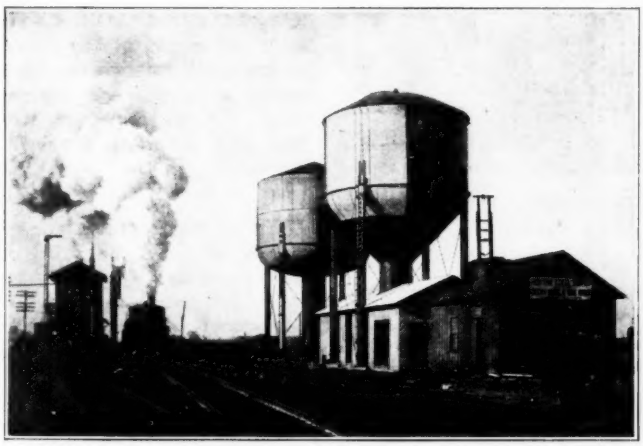


FIG. 7—ELLIPSOIDAL BOTTOM TANK (LEFT) AND COMBINATION CONICAL AND ELLIPSOIDAL BOTTOM TANK (RIGHT). THE LATTER IS CALLED A "CONICAL" BOTTOM TANK.

all familiar with the preparation of structural drawings and details, it will be apparent that the development of these diagonal struts is quite difficult and while Mr. Flad worked out the same very neatly indeed, the elimination of them entirely as accomplished by my father, greatly simplified the construction.

Figure 2a is a line diagram showing the method used by Mr. Flad to support the tank. You will note that the shell of the tank is carried 15 inches below the connection of bottom to shell and a pair of flange angles attached to shell

FIG. 8—ELLIPSOIDAL BOTTOM TANK FOR GENERAL WATER SUPPLY.

resting on top of post. The balcony indicated does not function as any material element, it being provided simply as a walkway. Also note that while the radius of the tank is 10 ft., the radius of the bottom is 11 ft., necessitating flanging the upper edge of the bottom plates where they connect to the tank. Had the bottom been made a full hemisphere it is apparent that the depth of the skirt must necessarily have been much increased in order that the bottom clear the top of column. It is also evident that some of the space between bottom and shell would have been completely inaccessible.

The First Real Hemispherical Bottom

Figure 2b shows the tank connection as designed by my father. You will note that there is no skirt and that the balcony forms a girder to take the horizontal thrust of the column, and while providing a good walkway, is a material element in the construction. By the use of this detail it was both possible and desirable to make the bottom a complete hemisphere and avoid flanging bottom plates at connection to the shell.

The above is the basis of our technically correct assertion that we were the originators of the hemispherical bottom tank.

Referring back to Figure 2a you will note that Mr. Flad attached a pair of angles to the shell at the connection of the bottom plates as well as the two bottom flange angles, thus forming a fancied plate girder—in this case about 15 ins. deep. This detail cost, I fully believe, at least 10 years of argument.

As these structures came into use other engineers prepared designs and illustrated them in text books and in the Proceedings of Engineering Societies. Some adoped the shell projection design, insisting that this girder effect was essential. We argued that the entire vertical side of the tank was the girder and they claimed that the skirt—of whatever depth chosen—could only be the girder, regardless of the fact that the web was continuous to the top of the tank. Some were so insistent that we had to yield, as naturally a purchaser's desires will dominate. We did, however, eventually prevail, as I do not believe we have had a discussion on this point for the last 15 years.

Figure 3 illustrates the cross-sections of two tank designs with composite bottoms discussed by the German engineering paper referred to, in 1886. We have never had an occasion to use a similar design. While possible, they would be difficult to fabricate, erect and make tight, and in my opinion therefore impracticable.

In the early years we, as well as others, built a few conical-bottom tanks but found them uneconomical. There is a large ring compression induced at the junction of cone and cylinder which requires quite a mass of steel to withstand —difficult, in fact theoretically impossible, to place exactly at the point desired, a criticism which also applies to tank bottoms constructed in the form of a spherical segment.

The Fort Dodge Tank

Figure 4 is a photograph of our first tank at Fort Dodge, Iowa. We made several minor mistakes in this work. The proportions of the tank—diameter and height—were not entirely pleasing. The bottom was made of too many small plates, difficult to develop, and which greatly increased the cost of fitting, riveting and caulking.

Figure 5 is a picture of our second tank, built at Paris, Illinois, in 1895. In this tank we corrected the mistakes made at Fort Dodge, and even to an engineer, the changes we have made since would scarcely be apparent. In fact, the only changes have been in minor details to overcome constructional difficulties, such as decreasing the pitch of rivets at some points where leaks are prone to develop, an easier method of attaching the roof, changing column makeup to sections which we could best carry in stock, simplifying strut and rod connections, revolving ladder, etc., etc.

Figure 6 is a photograph of our machine for forming bottom plates—a dishing machine we call it. These machines we have discovered are capable not alone of dishing plates into spherical, but into almost any other form desirable for tank construction without the use of special dies, although to be sure quite a degree of craftsmanship on the part of the operator is essential to economical production.

This discovery served us to good purpose because as time passed it became apparent that a tank with a hemispherical bottom was not generally the most desirable form.

We found that something of the same argument which favors building an elevated tank instead of a standpipe straight up from the ground, existed between high tanks of small diameter and shallow ones of larger diameter. The more nearly constant the head remains as the tank is filled and emptied, generally the better, meaning of course that the total vertical height of the tank should be a minimum —practically.

We discovered that a hemispherical-bottom tank is very much limited in this respect. As the diameter increases, the height reduces so fast that the tank becomes all, or nearly all, bottom—an entirely unsuitable form, objectionable not alone on account of appearance but because the shell would not have sufficient girder strength to carry the load to the columns. A bottom in the form of a spherical segment would answer but, as I have said before, induces heavy stresses at the point of its connection to the shell, difficult to provide for.

A New Design

Thus from Necessity, that splendid old mother of invention, was born our ellipsoidal-bottom tank, illustrated at the left in figure 7—first developed for railroad service.

The central portion of the bottom is, as you can see, comparatively flat and in tanks of any particular size must be

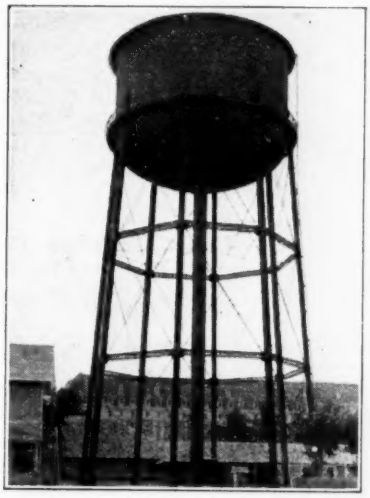


FIG. 9—500,000 GAL. ELLIPSOIDAL BOTTOM TANK AT MIAMI, FLA.

supported, as it has considerable flexibility up and down. The pipe connections to hemispherical-bottom tanks are made by means of an expansion joint, a hemispherical bottom being comparatively rigid. It is also necessary to insulate the riser pipe to prevent freezing, and even yet we have not discovered an entirely satisfactory frost casing.

The ellipsoidal-bottom tank which I think we can justly claim to have originated, overcame the objections I have cited. The proper ratio of diameter to height can be maintained. Instead of using a pipe protected with a wood frost casing, the best we know of, we substituted a riveted steel pipe large enough to act as support to the bottom, and also large enough to preclude the water inside from freezing solid. The bottom of the tank itself being flexible the riser can be riveted directly thereto, proper bearing insured, and the expansion joint

which is also a nuisance, dispensed with.

It is quite interesting to consider the evolution which has taken place even since our first ellipsoidal bottom tanks, which were primarily designed for railroad use. We have since discovered that the ellipsoidal bottom type is the best for general use, while a combination of ellipsoid and cone are preferable for railroad service.

The reason for changing to the ellipsoidal conical was that very often the water used by the railroads carries considerable

FIG. 10—300,000 GAL. ELLIPSOIDAL BOTTOM TANK AT FAYETTEVILLE, N. C.

sediment which in the conical form is more easily removed through the blow off valve located in the bottom. Figure 7 (right) illustrates this form.

Figure 8 is an elevated tank with an ellipsoidal bottom for general service. Its sturdy, stable appearance is in itself quite a recommendation. It immediately appeals and manifests its advantage over the hemispherical type. It has no wooden frost casing to rot, burn, and maintain, and no expansion joint to leak. It is quite apparent why this form is supplanting its progenitor.

Figures 9 and 10 show the same design for larger structures, figure 9 being a tank of 500,000 gals. capacity and figure 10 a tank of 300,000 gals. capacity.

More Development Probable

I have attempted in the foregoing to describe the evolution of elevated steel tank construction during the past 30 years. The advance has been as marked as in all other engineering endeavors. I often wonder what the development of the next 30 years will bring forth. No one knows better than I that we have not reached the ultimate goal.

Only within the last year some demand has arisen for another type of tank. The oil industry needs tanks in which to store volatile oils, where the weight of the oil and also internal pressure must both be taken into consideration.

Figure 11 shows some spherical tanks built for such purpose. The sphere is of course the theoretical form to resist internal pressure, and although not the exact form for combination of weight and pressure, nevertheless is close enough to commend itself, symmetry in construction being most desirable.

We are also just now being called upon to build spheres in which to store gas, the gas being pumped into the same and stored at pressures as high as 50 lbs. Preliminary investigations indicate that gas storage may be obtained more economically in this manner even for low pressure use, while for high pressure distribution which is now becoming quite general, the economies of this type of storage are particularly manifest. Undoubtedly we shall be building in the not distant future tanks of a form which have not yet occurred to us, for uses as yet unknown. There seems to be scarcely any limit in size. We have built them as large as 1,200,000 gals., the weight of the water carried being about 5,000 tons. Today, with the means we have available, we would not hesitate to undertake the construction of a similar structure three or four times as large.

There is seemingly an ever widening demand for their use. Thirty years ago all the tanks we could conjecture were those for use in connection with municipal water plants. Then came a larger demand from various public and private institutions; later the factories took more than the two preceding together; then the railroads, and now the private estates and large farms. Soon perhaps every farm. There are surge tanks as a protection for penstocks in water power developments, filter tanks, water softeners, fuel oil tanks, chip tanks for paper mills—the end is not yet, and never will be as long as our country continues to develop.

Perhaps you will permit me or my successor to continue the story at your meet-

ing twenty years hence. I hope that I may be able to do so, but whether I or my successor, there will be much to relate.

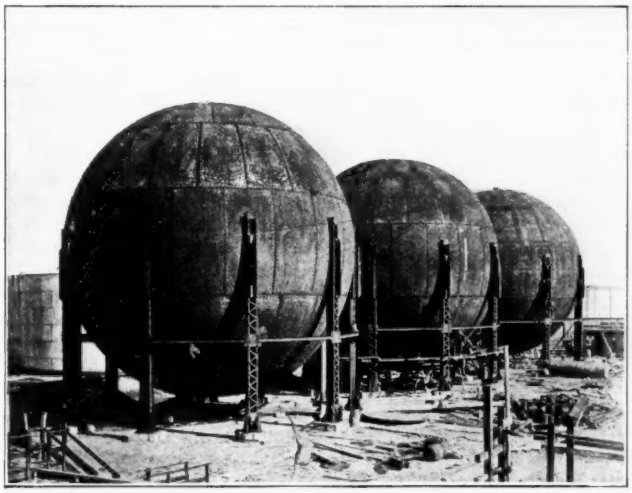


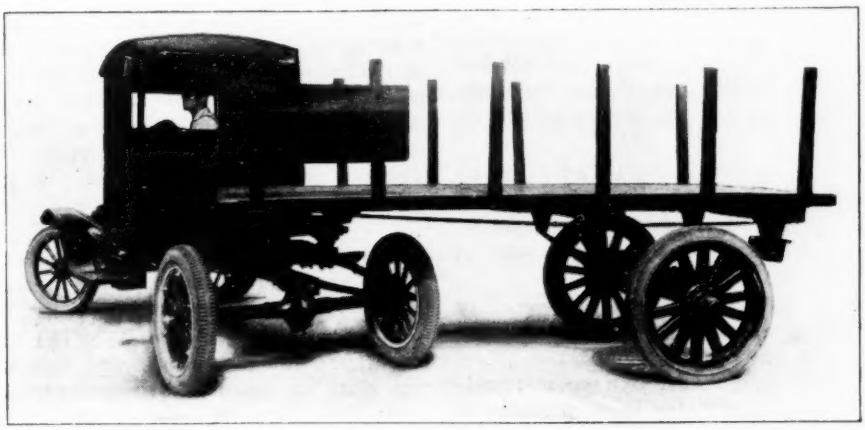
FIG. 11—HORTONSPHERES DESIGNED BY CHICAGO BRIDGE & IRON WORKS FOR THE STORAGE OF VOLATILE LIQUIDS AND GASES AND COMING INTO USE FOR ARTIFICIAL GAS STORAGE.

The foregoing paper by Mr. Horton was read at the 1925 meeting of the Illinois Society of Engineers.

TO MAKE 10,000 POPULAR PRICED TRAILERS

When Henry Ford, about 20 years ago, announced that he planned to make 10,000 automobiles in one year and sell them for $500 each, the other manufacturers smiled. They scouted the possibility of producing a 4-cylinder automobile that would sell for $500 and they ridiculed the idea that the country could absorb 10,000 cars of one make in one year. Today Ford makes almost that number in a day and sells them for a little more than half $500.

Following in Ford's footsteps comes the announcement that the Martin Fifth Wheel and Trailer Company of Springfield, Mass., will this year make 10,000 semi-trailers and by reason of this quantity production will be able to sell them at a price in proportion to the Ford truck.



THE MARTIN 3-TON STAKE BODY, SEMI-TRAILER FOR USE WITH FORD TRUCKS.

C. H. Martin, president of the company, says that a careful investigation of the potential trailer market has shown conclusively that there is a practically unlimited demand for trailers, but they must be produced in such quantities as will make it possible to sell them at Ford prices.

As a result of this investigation of the market possibilities and the cost of production on a quantity basis the Martin Company has decided to build 10,000 trailers this year to sell for $380, compared with $650 the cost of a trailer today.

Mr. Martin says there are 30,000 lumber dealers alone using from one to 100 trucks and teams each and the semi-trailer is especially suited to their business.

This is the first attempt at quantity production in the trailer field and the Martin Company believes the market is just waiting for such an article. The Martin Company plans an extensive advertising campaign and will put out a large force of salesmen with demonstrators.

SETBACKS FOR DAY LABOR ON GOVERNMENT WORK

Two recent Federal government actions tend to show that day labor practices in some branches of the national government are being forced to recognize the economical advantages of the contract system, according to "The Scraper," published by the Kentucky Association of Highway Contractors.

A distinct victory for those who stand as advocates of the straight contract method of handling public construction work is found in a recent action taken by the Committee on Public Buildings and Grounds of the House of Representatives.

This action consisted of adopting an amendment to Senate Bill 3173, which provides for construction of a memorial bridge across the Potomac River at Washington.

As passed by the Senate, the measure stipulated that construction of the bridge be handled "by contract or otherwise." This of course left the door wide open for a typical day labor situation to enter.

The amendment adopted by the committee provides that strict accounting be made of the job in the event that it be handled under the force account system. This sets a mark of recognition in high places of the fact that day labor methods invite a laxity not found in contract operations.

The text of the amendment follows: "Provided. That by contract or otherwise this work or any part thereof shall not be undertaken until complete designs, working drawings and specifications are made and competitive bids are taken, and if it be determined to do said work or any part thereof under any other method than by regular contract method, the said commission shall cause to be kept an itemized account of all moneys expended, including, among other items, all labor, materials, rental, repairs, transportation, of labor, equipment and materials, engineering costs, depreciation of government-owned equipment and cost of repairs to same."

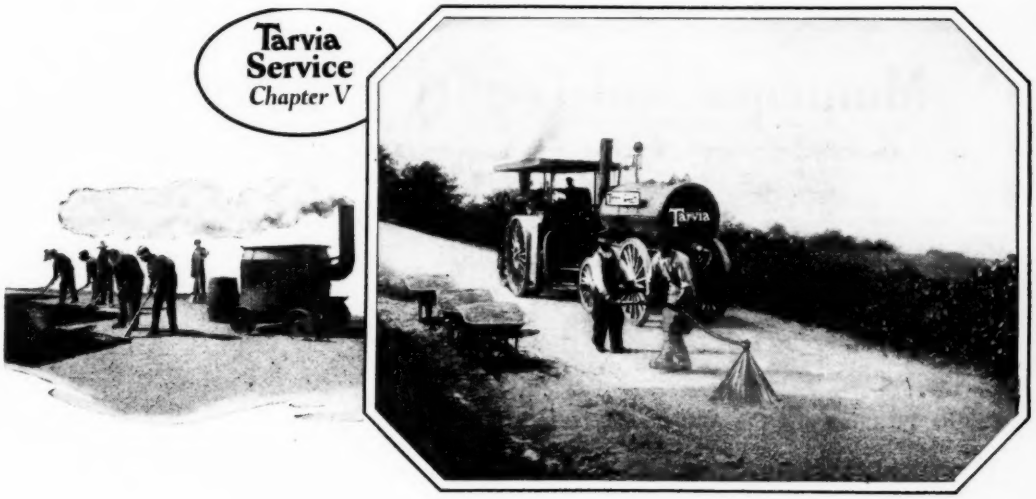
In the Bureau of Indian Affairs two contracts were recently awarded for earth excavation on two sections of the main canal of the Fort Hall project in Idaho. Heretofore this class of work has been done very largely by day labor employes of the Bureau. This result is to be credited to the efforts of the Associated General Contractors of America.

Section No. 1 was awarded to the General Construction Company of Spokane, on a bid of $83,450, and Section No. 2 was awarded to J. A. Terteling & Sons of Moscow, Idaho, whose bid was $45,250.

Following the opening of the bids, officials of the Indian Bureau indicated their belief that the offers were too high and were prepared to handle the advertised work by day labor methods. The A. G. C. then began efforts that lasted more than two weeks to convince the Federal officials the bids were not excessive in their figures. The case was taken up with Secretary Work of the Department of the Interior, as well as with those at the head of the agency supervising the project.

Success crowned the work of the Association's representatives who handled the situation when the Bureau officials announced two sections of the canal would be excavated by constructors on awards based on the bids received.

Tarvia Service *Chapter V*



Big economy for little jobs— with Tarvia tank-wagons

AT times the job doesn't justify the faster distribution by Tarvia tank-trucks. For instance—

In communities where it is necessary to do street work, a block at a time—or where interruption of the work is unavoidable—Tarvia tank-wagons are the logical solution. It's an economical thing to keep a Tarvia tank-wagon on the job until the job's done. The cost of renting one of these wagons for the duration of the job is negligible.

And like the Tarvia tank-truck, these tank-wagons are equipped with the patented Barrett nozzle which insures the uniform, unbroken distribution of the Tarvia on the road.

Tarvia tank-wagons stand as another example of Barrett service policy—a *right* Tarvia service for every type or size of job.

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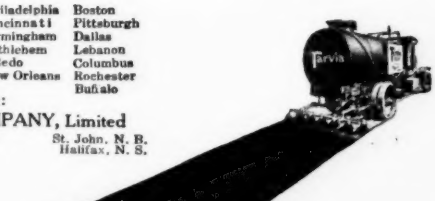
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